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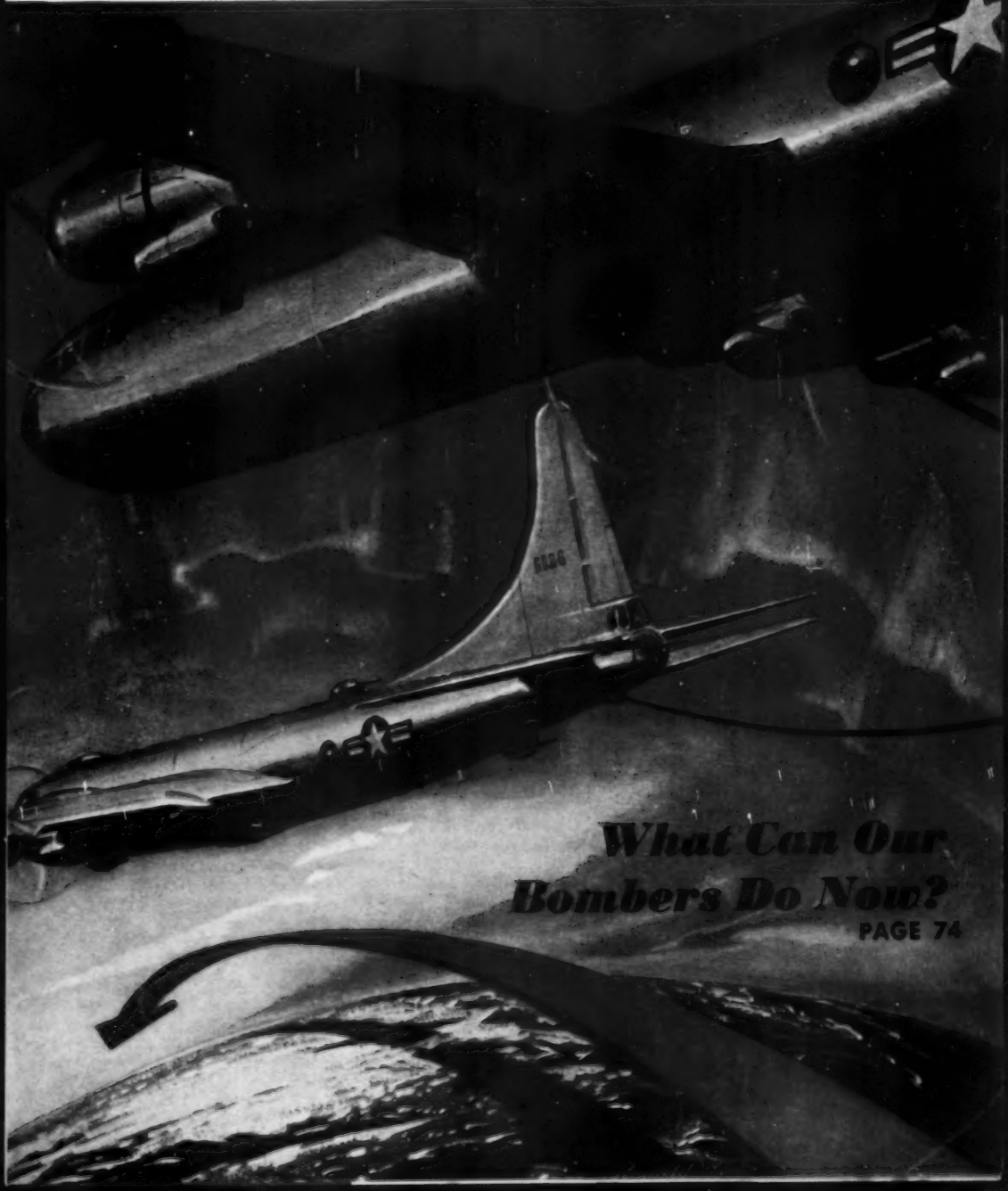

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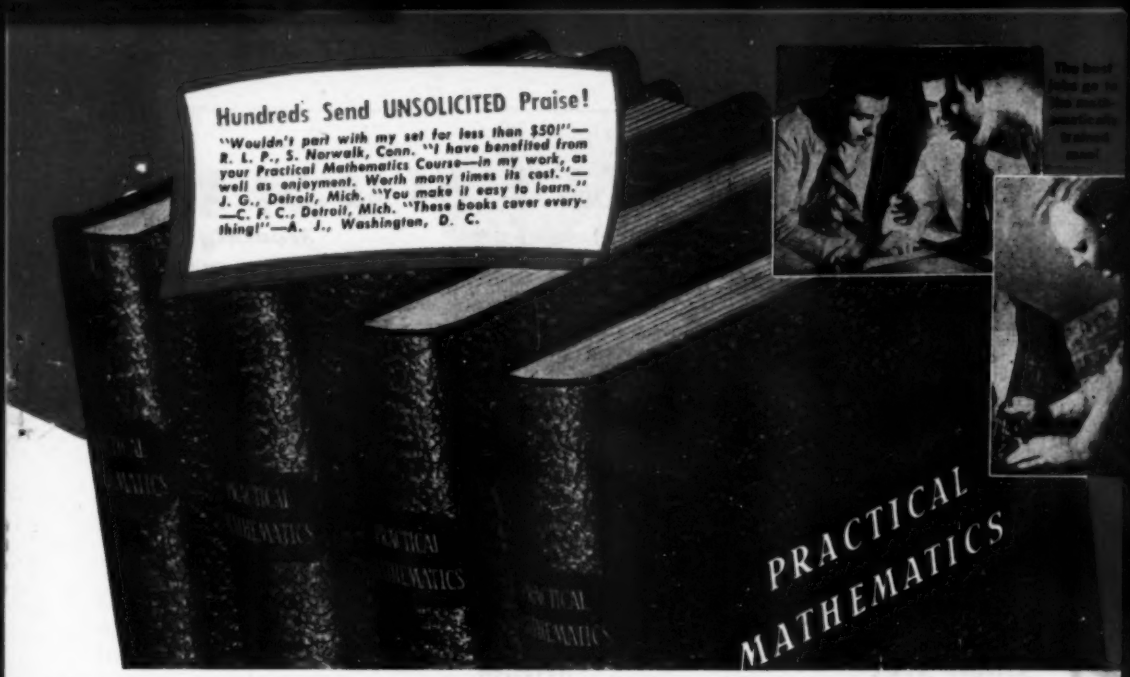

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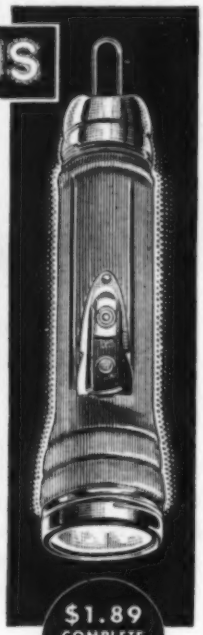

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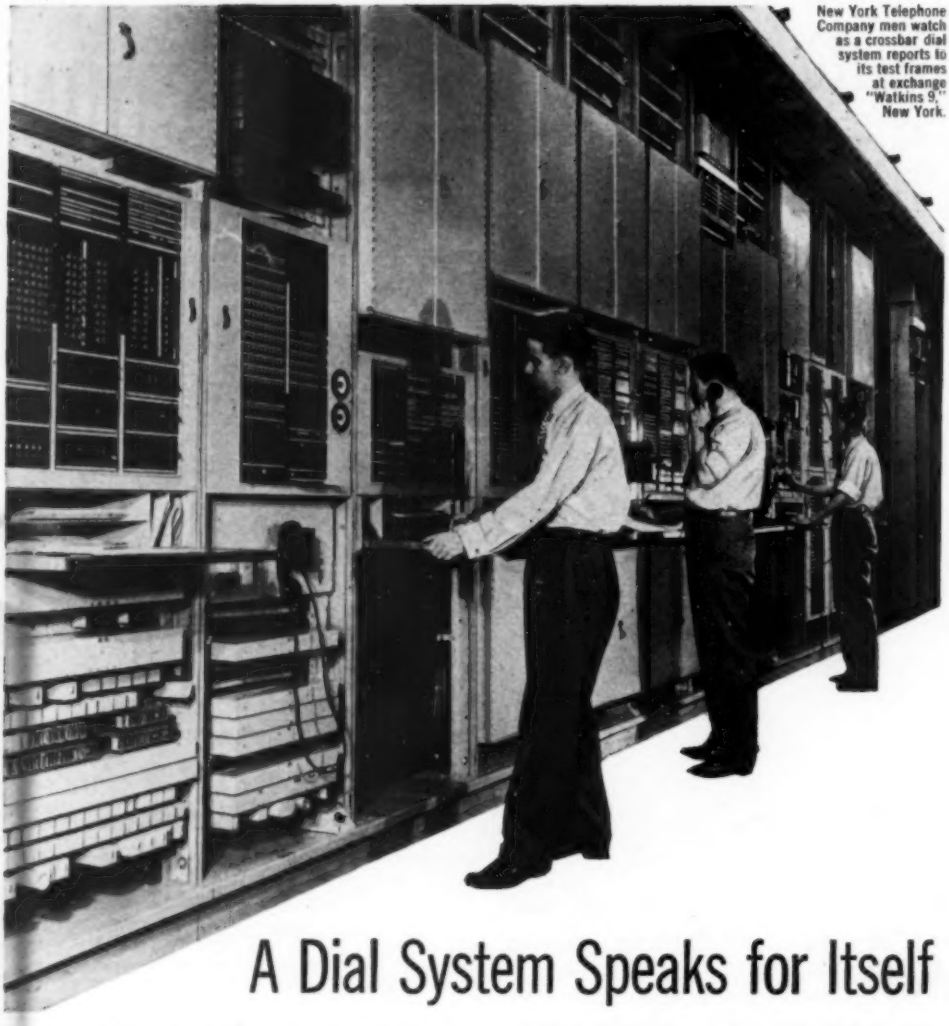

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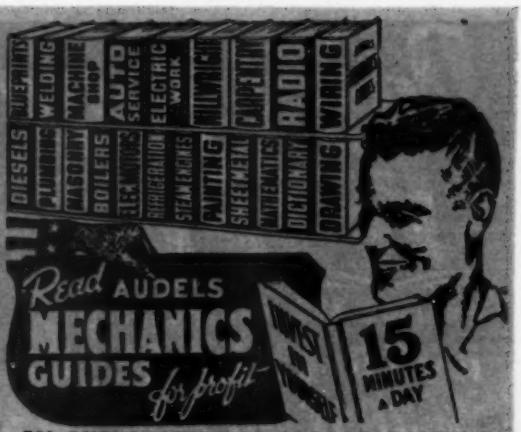

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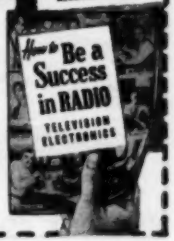

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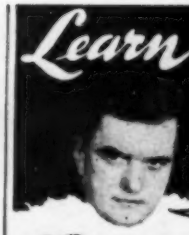

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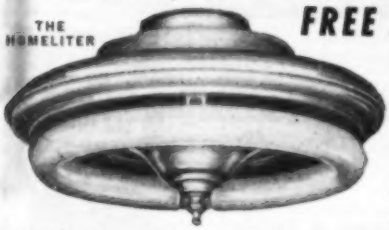

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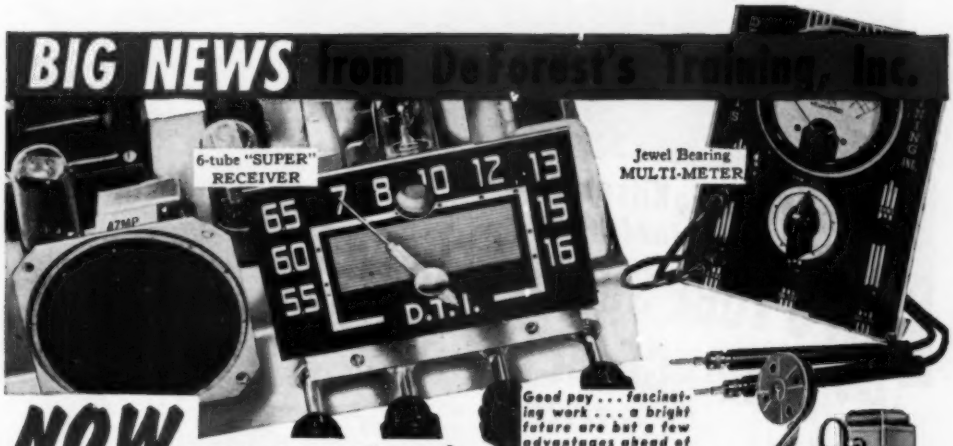

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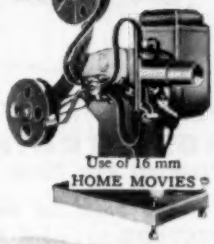

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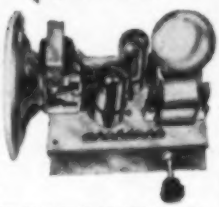

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A patent gives the inventor the exclusive right to prevent others from making, using, or selling the invention claimed in the patent for a period of seventeen years.

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Letters

PS in Safety Program

Sir:

I would like your permission to make about thirty photostatic copies of the article "Danger 115 Volts," which appears on pages 186 to 189 of the January issue of POPULAR SCIENCE. These copies would be for distribution among employees in our electrical department as part of our safety program.

E. V. LINDSETH
U. S. Department of the Interior
South Platte River District
Denver, Colo.

PS is happy to take part in this valuable safety-training program.

What a Memory!

Sir:

Some time ago you published a description of an easily constructed device to demonstrate the recalescent point of iron, by means of a heated wire and pointer. The author of the description was Raymond B. Wailes. Results were perfect if you followed directions. Without the right dimensions it was one of those things that you can work on for a year without success.

If you are able to give me the article I would appreciate it very much.

J. HAROLD BYERS
Washington, D. C.

After some extensive head-scratching and page-thumbing, our library staff finally came up with the answer. The article was "Hot Metal Strangely Rekindles Dying Glow," September, 1935, page 51.

Old Spikes with a New Twist

Sir:

It may interest you that the article on page 105, May issue of Popular Science, titled "Rails Held Rigid" is nothing new in railroading. I have been working for the Erie Railroad for the past 19 years, and we have used this type of screw spike. We know them as lagg screws. We use the same method of starting those spikes, but we do not drive them all the way down. We set the spike with a hammer and then screw it

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Patent laws encourage the development of inventions.

We recommend that an inventor employ a registered Patent Attorney or agent, if the inventor is not familiar with patent matters. This is because the value of a patent depends largely upon the skillful preparation of the specification and claims in the patent application.

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If an inventor believes he has an invention, a search of the most pertinent prior U. S. patents should be made and a report obtained relative to its patentability. Where such report indicates that the invention appears patentable, in order to secure protection, diligence should be exercised in making application for a patent.

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☐ Check here if Veteran of World War II D

down the rest of the way with a wrench. . . .

D. A. MECCA

Dunmore, Pa

Yes, but the newer spikes PS described do not have to be screwed in. They are hammered down and screw themselves in, saving time and work. That's the difference.

Patience Proves Its Virtue

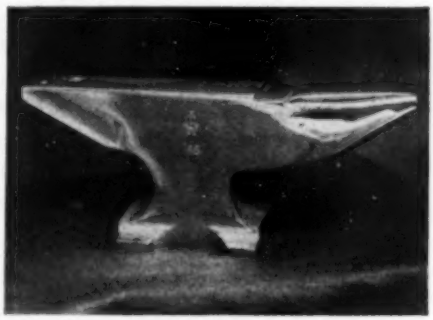
Sir:

Enclosed, find a photo [below] of one of your home shopcraft projects.

I made it from a piece of scrap-iron 5"x1½". The finished anvil measures 4" long, ½" top surface wide, base 1"x1½".

Being a maintenance mechanic in an Oregon shipyard, I had a little spare time between repairs on cranes, drill presses, etc.

Other than using a power hack-saw, I finished it to shape with a hand hack-saw and assorted files. . .



As this is my only attempt of this nature, I would be thrilled and very pleased if you could find space to publish the picture to show it doesn't take power lathes, etc. to turn out a job, if one has *patience*.

EDW. PRATER

Pocatello, Idaho

Radioisotopes for World Peace

Sir:

The Department is preparing an educational photo exhibit and filmstrip on the general subject of the use of radioisotopes in research for distribution to its missions in countries outside the United States.

We should like to enlist your assistance in providing us with a selection of 8 x 10 glossy photographs, fully captioned, together with any descriptive material or articles

INVENTORS

A Patent is a Valuable Right. On the basis of a provision in the Constitution of the United States, Congress has established a system under which inventors may secure the exclusive right to prevent the unauthorized use, manufacture and sale of their inventions for periods of seventeen years. The inventor secures this protection for his invention by obtaining a United States Patent.

This firm is registered to practice before the U. S. Patent Office and is available to assist inventors in the preparation and prosecution of their cases. Detailed information and the steps to be taken in obtaining patent protection will be furnished upon request.

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HARRY S. CASLER
International Press and Publications Division
Department of State
Washington, D. C.

PS is glad to be of help in this important work and is sending Mr. Casler the information he requests.

Science vs. Art

Sir:

Cartoonist for Mrs. Bob Smith's "You Can't Pull Wool Over Baby's Head, etc." ["What's Your Ingenuity Quotient?" June '48, p. 161] must have visioned a freak woman with ability to make balloons float with human air. Idea is not a bad one tho'.

C. H. BARNES
Duluth, Minn.

PS is guilty of taking slight liberties with the laws of physics for the sake of art, but the idea works just as well even though the balloons won't float.

More on Red and Green Air

Sir:

Regarding the standing wave (alias Moazagotl) ["Flying in Red and Green Air," PS, July '48, p. 91] found mostly in the lee of high mountain ranges, it is created by cold air encountering a high mountain range. It collects on the windward side until it reaches high enough to flow through mountain passes and finally over the entire range.

On the lee side it flows off creating a precipice of cold air. Warmer air currents (condition usually exists when there is an inversion, hence the warm air) fall down the precipice of cold air, then bounce upward, creating large standing waves which extend well into the stratosphere.

ALEXIS DAWYDOFF
Air Trails
New York, New York

One on Galileo

Sir:

Regarding the argument in the June issue

There's BIG MONEY in

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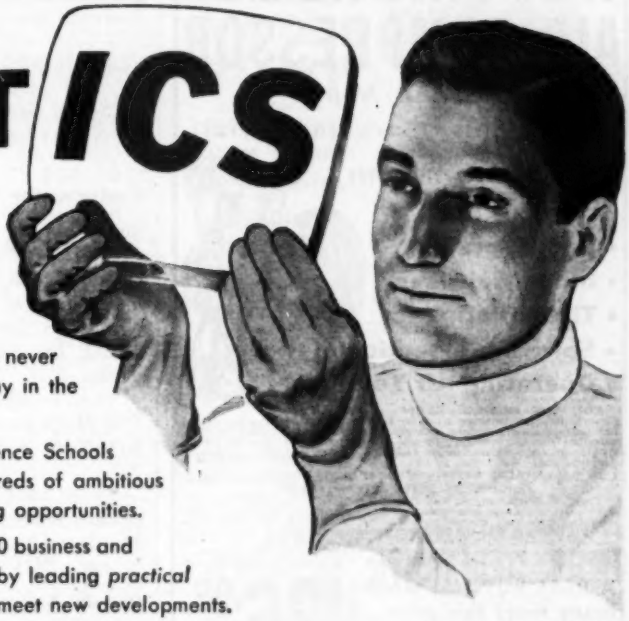

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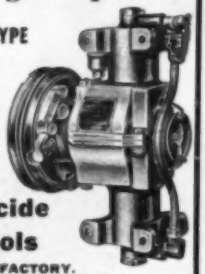

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["Letters," p. 20] about the weighted fountain pen cap, I would like to submit my conclusions from observed facts. Namely, that when I drop a slice of buttered bread it always lands buttered side down.

PAUL SWANSON

Flint, Michigan

Galileo should know, but perhaps he just never used butter on his bread.

Underwater Radar All Wet

Sir:

. . . I hate to be naive, but I would like to know what kind of radar discovered the mountain 2760 feet below the surface of the ocean [PS, June '48, p. 96]. Such a radar would be invaluable for anti-submarine work.

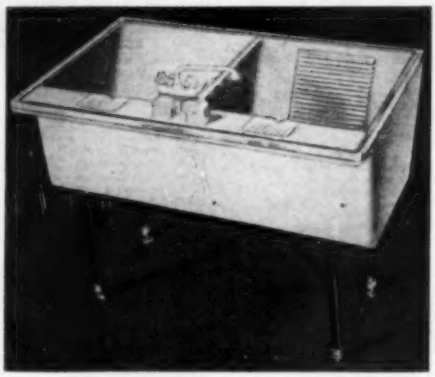
ENS. M. M. MCLEOD, USN
USS *Hugh Pervus*, DD 709
New York, N. Y.

Radar can't penetrate water, but PS can, since it is obviously all wet. The mountain was found by a sound-echo detection device.

Quick Answer

Sir:

Being a subscriber of PS, I noticed in the March issue on page 112 a Mrs. W. Dunaway wishing for built-in washboards in laundry tubs.



Being employed by one of the largest plumbing manufacturers in the country, I know that this type of laundry tub [shown above] is made and has been for many years.

T. J. VON DRASEK

Brookfield, Ill.

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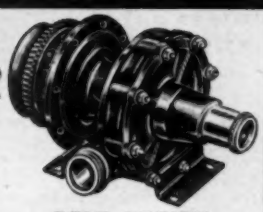

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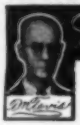

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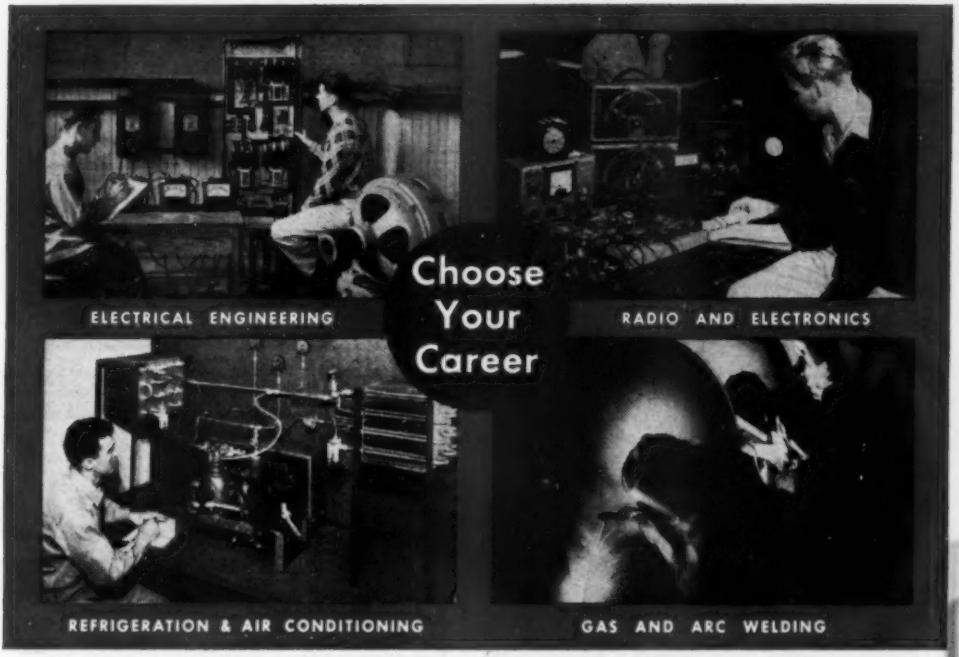

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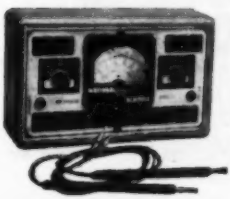

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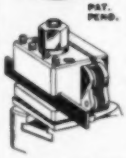

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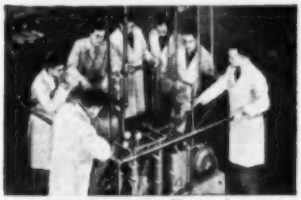

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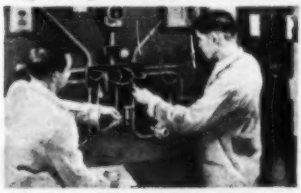

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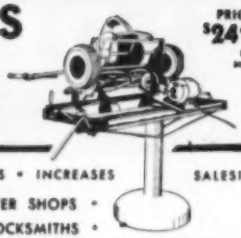

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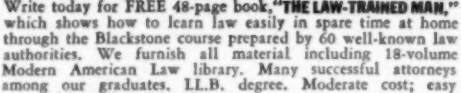

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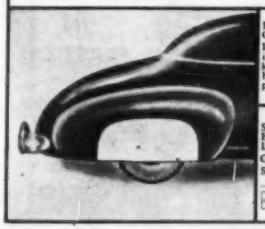

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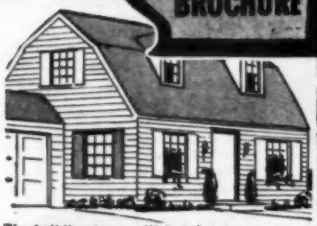

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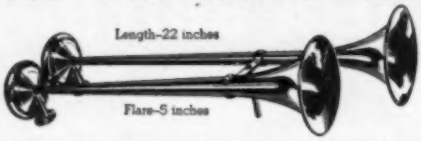

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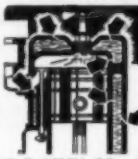

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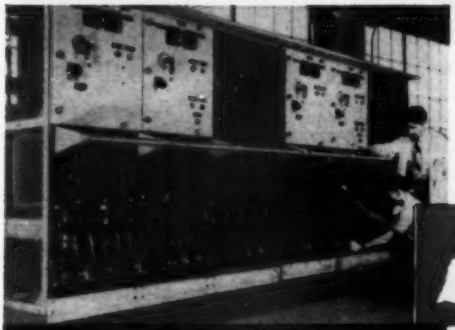

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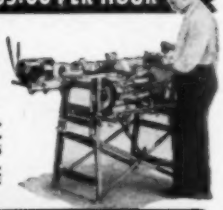

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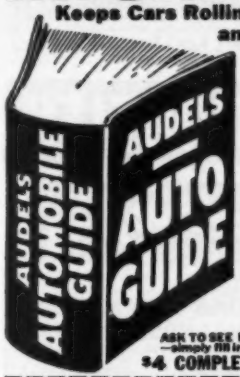

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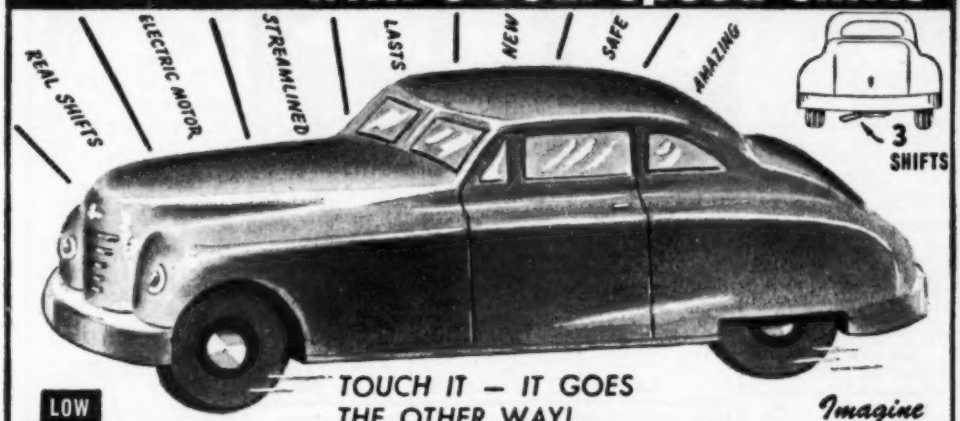

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Has spare bulb in handle.

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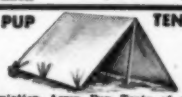

Regulation Army Pup Tents of durable, brown canvas. Used, but in good condition. Fine for campers, outdoorsmen, Boy Scouts, etc. Wgt. 5 lbs. **A100**—Tent only.... **$3.95**
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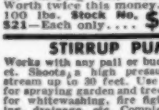

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ELECTROPLATE on leather, plastics or metal. Instructions $1.50. Four ampere plating unit with instructions $19.95. Eight ampere unit $29.95. Kissel Electric Products, 431 Sherman, Galion, Ohio.

BRONZED Baby shoe mountings and supplies. All metal bronze bookends, picture frames, ashtrays, etc. Onyx ashtrays, desk sets, placques. Hardening solution. 30-amp plating rectifiers with powerstat control $85.00. Geared motors for agitation $20.00. Lead lined tanks. Write for list. Hollywood Bronz Supply, Dept. S, 1770 N. Vermont, Hollywood 27, Calif.

HOW and where to obtain capital. Particulars free. Star Service, Wapakoneta, Ohio.

SELL quality paints for established manufacturer. Exclusive territories, good year-round earnings, factory cooperation. No capital or experience needed. Write Standard Industrial Products, Inc., Dept. PS-1, Evansville 4, Indiana.

REUPHOLSTER Your own car or operate upholstery shop. Complete auto upholstery instruction manual $2.00 Money Order. C.O.D. First Upholstery Service, 3439 Michigan Ave., Chicago, Ill.

ALL kinds American, Swiss watches, new and used; retail $3.65—$345.00; profit 33⅓% up; show our catalogue, get orders. Brookings, B-CH1975, Little Rock, Ark.

FREE Folio—400 Money Making deals. Business plans. Schemes. Formulas. Formico Prod., Box 572, Dayton, Ohio.

RUBACREAM! Natural Rubber Latex! Makes molds quicker! Thicker! Free Sample convinces! "Rubber Castcraft Studios, 509-S Fifth Avenue, New York 17.

BABY Shoes preserved. Formulas. Instructions $1.00. Supplies & Bases. Novelty Bronzing. Box 56, Hyde Park 35, Mass.

$46 FROM Square Foot Plywood; Jigsaw necessary. Write; Woodart, Bridgewater, Massachusetts.

I MAKE big money in the mail-order business. You can do the same at home with copyrighted system. Write me, I'll tell you how. F. Little, Rd #1, Glenshaw, Pa.

MONEYMAKERS! 300 are in 40,000 word book. 25c—"Moneymaking Secrets Exposed." 50c. Satisfaction guaranteed! Publications, 2618-PH Ellendale, Los Angeles 7.

$10.00-$20.00 WEEKLY, spare time. No canvassing. Free literature. Teepee Co., Cleveland 3, Ohio.

RUBBER: White liquid rubber! America's finest flexible molding rubber! New! Extra heavy viscosity! Quick drying! Ideal for home, classroom, or industry. Only $7.95 per gallon, $2.95 per quart, and $1.00 per half-pint sample. Parcel post prepaid! Plastercraft Supply Company, 3051 St. Clair Ave., Cleveland 14, Ohio.

57 MONEY MAKING OPPORTUNITIES

DETECTIVES Earn Big Money. Experience unnecessary. Particulars free. Wagner, P-135, West 86th, N. Y., N. Y.

EARN several thousand yearly handling advertising pens. Permanent. Arrow Press, (Dept. S), Box 933, Buffalo, N. Y.

21 MONEYMAKING candy apple, popcorn formulas. Send $1.00 M. O. We can supply equipment for starting very profitable popcorn, candy floss business at little cost. Concession Supply, Dept. B, Sta. "B," Toledo, Ohio.

SHELLCRAFT! Make beautiful seashell jewelry. Income - or - Hobby! Large illustrated catalog! Supplies, instructions. 10c Postage (Buy Direct From Manufacturer) Face's, Box 279-S, Bradenton, Florida.

IF you work in a factory or shop, you are passing up the opportunity of a lifetime to build a steady Extra Income by selling subscriptions to Popular Science Monthly to your fellow employees. For free kit and complete instructions write on a postcard to—Manager of Agents, Dept. A148, Popular Science Publishing Co., Inc., 353 4th Ave., New York 10, N. Y.

CARS . . . Cash . . . Homes . . . Free to lucky contest winners! Win your share with our contest aids. $1.00 brings Prize Contests Bulletin. Winning answers, entry blanks . . . Literature free. Prize Contests Company, Station "P," Dept. 12-P, Brooklyn 12, New York.

HOW to address envelopes for profit. 10c and stamp. Cy, 2233 Eastern Av., Indianapolis 18, Ind.

WIN contest money. General Contest Magazine gives hundreds of tips. Lists current contests and rules. Sample 25c. General Contests, 1609-A East 5th, Duluth, Minn.

START your own business! Big money manufacturing novelties, plaques, statuary. Free catalog. Write Bing Products, 68-B8B Broad Street, Boston 10, Mass.

MAKE Money making Honey Formula. $2.00. S. Sumerville, Hazel, Butler, Pa.

LEARN to make seashell jewelry, pens, earrings, hair ornaments, novelties. Design and instruction book free with $2.00 and $5.00 kits. Also artificial flower supplies. Herbert Dimond Co., Box 4619, Miami 31, Florida.

YOUR Telephone can make you money! New development. Substantial possibilities. No stock or selling! Investigate now! Information, $1.00. Francis, 4638-B Northeast 34, Portland, Oregon.

EARN Money evenings, copying and duplicating comic cartoons for advertisers. Adservice 2, Argyle, Wisconsin.

MAKE sell proven sellers exotic novelties. Sample instruction. Burton, Pinnillas Park, Fla.

WOULD You pay 3%—first $350 made? Color-illustrated book "505 Odd, Successful Enterprises" free. Expect something odd! Pacific, Oceanside, California.

PRIZE Contest Fans Reap Rich Rewards. Enclose 3c stamp. National Contest Bulletin, Box 2685-S, Miami 31, Fla.

DON'T take orders from anybody! Be your own boss with help of big new book "How To Start Your Own Business." 60 fields covered. Money back if it doesn't help you! Send $1.98 to Foremost Books, Dept. PS-88C, 353 4th Ave., New York 10, N. Y.

CASH In on big demand with your own Electroplating business! Big 256 page illustrated book "Electroplating" tells how. Send $2.49 to Popular Science, Dept. 88C, 353 4th Ave., New York 10, N. Y. Satisfaction or refund guarantee.

MERCHANT seamen earn big pay. Complete information how these jobs are secured $1.00. O. Coffee, Box 844, Sta. H, Los Angeles.

WIN Contest money, send 25c guaranteed instructions for writing winning answers. Winacontest, 22 Westlake Ave., Auburn, New York.

58 FORMULAS, PLANS, ETC.

FORMULAS for twenty-five useful products. One Dollar. Chemist, Box 274, West De Pere, Wisconsin.

OPPORTUNITIES! Catalog describing 200 Helpful Formula, Money-Making Books, Air-mailed throughout world for stamps. Adams-Brown, Boston 67, Mass.

FORMULAS—All kinds. Latest products. Literature free. Kemico, Park Ridge 15, Illinois.

400 MONEY Making Deals, Formulas. Mfg. secrets. Tips. Folio Free. Formico-NA, Box 572, Dayton, Ohio.

TESTED formulas. Interesting descriptive booklet free. Pont, Box 635-PS, Terre Haute, Indiana.

10,000 FORMULAS and trade secrets. Free literature. Stillmans, 555 Kingston Ave., Brooklyn 3, N. Y.

DYES, Soaps, Detergents, Dentifrices, cleaning fluids, bleaches, polishes, adhesives, cosmetics. 1,001 other formulas in big book. Save money—make money! Order "Book of Formulas" C.O.D. or send $1.49 to Popular Science, Dept. 88C, 353 4th Ave., New York 10, N. Y.

59 PLASTICS

PLASTIC—Sheets, Rods, Tubes, etc. Free List. Plastic Supply Co., 2618 St. Louis Avenue, St. Louis 6, Mo.

LUCITE. Plexiglas. All size sheets. Cost square foot (12" x 12") 1/16" 90c; ⅛" $1.16; 3/16" $1.43; ¼" $1.68; 5/16" $2.09. Include 10% postage. Almac Plastics, 230 Fifth Ave., N. Y. 1, N. Y.

SUMMER Special. 1 each 6" x 12" Masked Plexiglas Sheet. 1/16", ⅛", 3/16", ¼" $3.00 Postpaid. Free Listings. Craft Plastics, Somerville 1, New Jersey.

BOOK-Illustrated. Fabricating, forming Lucite. Simplified methods, projects. $1.00 P.P. Ideas-D, 11379 Ventura, North Hollywood, Calif.

INTERNAL Carved swans, bluebirds, goldfish, butterflies, etc., pins, $1.50. Rose or Daisy costume jewelry sets, $1.50 less findings. Also gifts and novelties. Crystal Floral Novelty Co., Somerville, New Jersey.

LUCITE. Plexiglas, bakelite, acetate; sheets, rods, tubes; clear, colored. Internal carving blocks, dyes, cements. Free price list. Martin Plastics Co., 68 Arcade Bldg., Providence, R. I.

60 CHEMICALS AND APPARATUS

LEARN Chemistry at home, from the House of Winn. Home of Supplies for student Chemists. New idea chemical and apparatus outfits for Home Experimenting. Photographic Scales. Semi-Professional Microscopes and accessories. Send 15c for retail catalogue. Established 1931. John H. Winn, 124B West 23rd Street, New York 11, N. Y.

INTERESTING Catalogue Rare Elements. Chemicals small quantities, processes. Dime refunded first order. Vicar Laboratories. Established 1916. Guerneville, California.

NEW Laboratory supply catalog of chemicals and apparatus. Contains many thousands of items with illustrations. Send 25c. Standard Science Supply Company, 1232 N. Paulina St., Chicago 22, Illinois.

HANDBOOK for Chemical Experimenters. Hundreds of Experiments; Illustrated. 50c. Experiment Booklet. 15c. Supply Catalog. 5c. Reading Scientific Co., Reading, Penna.

FREE catalog: Chemistry, mineralogy, biology, physics. Tracey Laboratories, Evanston, Illinois.

TERRIFIC bargains in chemical laboratory apparatus—Catalogue 10c. Ross, Section B, 68 West Broadway, New York, N. Y.

CHEMICALS and apparatus for industrial, analytical, and private laboratories. Catalog 10c. Dept. M-26, Biological Supply Co., 1176 Mt. Hope Ave., Rochester 7, N. Y.

CHEMICALS, ounce quantities, apparatus, catalog 10c. Fleischer's Laboratories, Everett 49, Mass.

61 HELP WANTED

IF you work in a factory or shop, you are passing up the opportunity of a lifetime to build a steady Extra Income by selling subscriptions to Popular Science Monthly to your fellow employees. For free kit and complete instructions write on a postcard to—Manager of Agents, Dept. A148, Popular Science Publishing Co., Inc., 353 4th Ave., New York 10, N. Y.

EARN up to $520 month part or full time keeping books for small firms. Simplified system. Write Tax-Saver System, Dept. B, Ft. Worth, Texas.

FOREIGN Employment? July directory, application forms and bulletin 39-B. $1.00 or C.O.D. Foreign Service Institute, Box 3934-A, Miami 24, Fla.

62 AGENTS WANTED

GOOD Paying Business Silvering mirrors, plating autoparts, reflectors, bicycles, bathroom fixtures, etc., by late method. No tanks or shop required, outfit furnished. Free Booklet. Gunmetal Co., Ave. G, Decatur, Illinois.

EXCELLENT Sideline for printing and advertising salesmen. Decalcomania name plates in small quantities. Great demand. Also, make money with our line of Automobile Initials and Sign Letters. Free Samples. "Ralco", XL-Roxbury, Boston 19, Mass.

AGENTS—300% profit selling genuine gold window letters; stores and offices. Free samples. Metallic Letter Co., 437 N. Clark, Chicago.

JOBS Open In Selling! Send name, address for Free copy Opportunity Magazine, listing hundreds of companies who need men now, full or spare time. Experience not essential. Opportunity, 28 E. Jackson, Dept. 15, Chicago 4, Ill.

BIG Money Quickly and Easily taking orders for complete line Personalized Initialed Buckles, Belts, Cap Badges, 2,000 Emblems. Fast repeats. Write today. Hook-Fast Company, Box 480-PS, Roanoke, Virginia.

MAKE more money selling personal initialed individualized belts, buckles, cap badges, tie holders, name plates, 2,000 emblems to choose. Big profits, whole or part time. Write today—special outfit order. Hookfast Specialties, Box 1425, Dept. 7, Providence, Rhode Island.

SELL new, used clothing from home, auto, store. Wholesale catalog Free. Calumet Sales, 4719 Kennedy Ave., East Chicago, Indiana.

SALESMAN: $20 to $30 a day easy. Sensational new Raised Letter Metal Nameplate, beautifully framed in Mahogany. Amazing seller in homes, stores, offices, etc. No deliveries. Get our tested plan. Write Raised Letter Metal Co., Dept. 2278, Fox Bldg., Philadelphia 3, Pa.

ADVERTISING book matches—Cash in on Political campaigns—sell Union Label matches. Cuts for all businesses and political parties—Free powerhouse selling kit—low prices—protection guaranteed on repeat orders—Cash commissions. Superior Match Co., Dept. P-88, 7530 Greenwood, Chicago.

A DRESS yours with every 3 you order for yourself and family. Amazing new bonus plan. Everything Free. Harford Frocks, Dept. R-9129, Cincinnati, Ohio.

CALL on friends with sensational Christmas Cards in handy assortments. Sell for $1.00. Profit up to 50c. Also popular-priced Personal Christmas Cards. Everyday assortments. Stationery. Imported Napkins. Samples on approval. Wallace Brown, Dept. H-4, New York 10, N. Y.

FREE sample! Big profit opportunity with amazing Glow-In-The-Dark House Numbers, switch plates, pictures, decals, religious articles. Represent large manufacturer. Madison Mills, 303 Fourth Avenue, New York 10, N. Y.

GUARANTEED product in protected territory, if you are now selling or intend to sell house-to-house. For full 1 Qt. Sample amazing High Shine Windsor No Rubbing Wax, send only 25c covering handling and postage. (Sells for $1.25). Windsor Wax Co., Inc., Dept. P.S.-2, Hoboken, N. J.

PLASTIC Christmas cards. Exclusive new plastic, sachet, panoramic, and carols Christmas assortments. Five leading 21 card $1.00 feature assortments. Six portfolios of personal cards. All this plus America's fastest imprint service. Free samples. Elmcraft Card Co., 5930 South Western, Chicago 36, Ill.

$25 YOURS for selling only fifty $1.00 boxes, new exclusive different Christmas and all-occasion cards; also extra cash bonuses. Send for Champion Cheerio 21-card box on approval. Free samples 6 new personal groups and stationery. Write today. Dept. 37, Pen-Brush, 154 Nassau St., New York 7.

AGENTS distributors, flo-glo plastic linoleum finish. Acme, Box 404-PS, Mount Vernon, N. Y.

SELL Gold embossed monogram stationery. Sample free. Dunbars, Sanford, Fla.

BIG Profits selling personalized rust-proof metalgram initials for autos, motorcycles, luggage, etc. Thousands waiting to buy. Unlimited opportunities. Generous samples. 3 styles (your Initials) and complete details only 50c (coin). Metalgrams, 1945 74th St., Brooklyn 4, N. Y.

AMAZING Profits $25.00 for selling 50 $1.00 DeLuxe Xmas boxes—embossed 50 and 25 for $1.00 name imprinted. Free samples. Ed-Brite, Dept. 8-A, 435 North Terrace Avenue, Mt. Vernon, New York.

SHINE Shoes without "Polish." New invention. Lightning seller. Shoes gleam like mirror. Samples sent on trial. Kristee 125, Akron, Ohio.

$5.00 CASH advance commission every sale. 38-piece "Lady Ann" silverplate table service. Guaranteed quality, value bring sales galore. Sells for only $4.95, including tarnish-resistant chest. Bonus premiums. Write for free Outfit. Dexter Silver Co., 303 Fifth Ave., Dept. PS-8, New York.

EARN $100 a week and more selling nationally advertised aluminumware, silverware, pressure cookers, canners and gift items. No investment required. Simply take orders, collect commissions, we do the rest. Complete sales kit free. Write Ury Co., Dept. 39C, 222 4th Ave., New York 3.

I'LL Put a "Shoe store Business" in your pocket! You get everything Free! We train you to pile up big profits through exclusive factory fitting service. Year 'Round repeat business. You draw on 100,000 pairs for men, women. Leading line of its kind. Nationally Advertised. Write today for Free sample outfit! Victor Thomas Shoe Co., Dept. V-162, Chippewa Falls, Wis.

AT Last! Something new and sensational in Christmas Cards. Gorgeous satin, velour designs never before offered. Amazing value! Gets orders fast. Name-imprinted Christmas cards, 50 for $1 up. Big profits. 30 other assortments 60c to $1. Imprinted Stationery. Samples on approval. Puro Co., 2801 Locust, Dept. 841-K, St. Louis, Mo.

PROFITABLE fast seller household specialty. Flinsen, Box 433-B, Kansas City, Mo.

FAST Selling line beautiful Christmas and all-occasion assortments, gift wrappings, personalized stationery, matches, playing cards, coasters, napkins, guest towels. Profits to 100%. Free samples 50 for $1.00 personal Christmas cards. Special offer. Write Senrab Co., 212 West Washington St., Syracuse, N. Y.

SELL Sho-card signs. Proven popularity. Large profits! Send $1.00 for 15 samples. Glen Arbor, 1411 Ann Arbor, Flint 3, Mich.

NEW extra money plan. Make up to 100% profit—without experience—showing Christmas, every day card assortments, wrappings, stationery, coasters. Unusual, attractive. Bonus. Special offers. Send for free samples 30 different name imprinted Christmas cards, 50 for $1.00, 25 for $1.00 and $2.00, stationery, coasters, Christmas, everyday assortments on approval. Thomas Terry Studios, 90 Union Ave., Westfield, Mass.

IF you work in a factory or shop, you are passing up the opportunity of a lifetime to build a steady Extra Income by selling subscriptions to Popular Science Monthly to your fellow employees. For Free kit and complete instructions write on a postcard to—Manager of Agents, Dept. A148, Popular Science Publishing Co., Inc., 353 4th Ave., New York 10, N. Y.

QUICK cash. Sell friends wonder value name imprinted Christmas Cards 50 for $1.00 up to 25 for $2.50. 43 sensational money makers. Up to 100% profit. Bonus. Special offers. Write for 9 Free self-selling sample portfolios name imprinted Christmas Cards and stationery. Rainbow Greeting Card Co., 38 East 1st St., Dept. 18-A, New York.

EASY money. Sell 50 all embossed Christmas Cards for $1.00 with name imprinted. Sensational new 21 card Christmas assortment sent on approval and free samples of all name imprinted Christmas cards. Lorain Art Studios, Dept. M30, Vermilion, Ohio.

GOLD lacquered Window Sign Letters. Large Sizes Penny Each. New Foils. Absolutely Beautiful. Free Samples. Atlas, 544 W. 79th, Chicago 20.

EARN Big Money Year 'round. Be a one-person-department-store. Take orders for shirts, ties, hosiery, lingerie, Household linens, etc. For information Corporative Merchandisers, Dept. PSS, 110 West 34th Street, N.Y.C. 1.

$1.00 STARTS you in business. Sell lined ties. 100% wool interlining. Costs you only $7.00 per dozen, you make $5.00 dozen. Send $1.00 for special introductory offer two ties. Catalog complete line Free. Philip's Neckwear, 20 West 22nd St., Dept. P-25, New York 10.

REAL Live Mexican jumping beans. 18—25c. 125—$1.00. 500—$3.00. 1000—$5.00. J. J. Frank, 525 Palm, Rockford 3, Illinois.

BIG Money. Sell friends, others, exclusive Christmas card assortments unobtainable elsewhere. Profits to 100%. Bonus. Request free samples exclusive 50 and 25 for $1.00 name imprinted Christmas cards with Christmas and everyday assortments on approval. Regal Greetings, Dept. PS-3, Hazel Park, Mich.

BIG, easy profits to 100% selling new, novel Christmas Card, gift wrapping, panorama, Christmas Carol assortments. Bonus. Special offers. Request free samples 50 for $1.00. Personals, silver imprint line, name imprinted and floral stationery and feature Christmas samples on approval. New England Art Publishers, North Abington 191, Mass.

AMAZING offer—$40 is yours for selling only 50 boxes, each containing 25 new, entirely different Deluxe Christmas cards with or without name imprinted. Also 50 for $1.00 free samples. Other boxes on approval. Write today. It costs nothing to try. Cheerful Card Co., 384 White Plains, N. Y.

AMAZING new items for housewife, automotive, industrial, no competition. Solvent Manufacturing Company, Holyoke, Mass.

SELL ultra-blue stock signs to stores. 1000 slogans, comedy, general, religious. "7x11" cost 6c—Sells 35c—Make money. 15 samples Ultra-blue signs "7x11"—$1.00 postpaid. L. Lowy, 8 West Broadway, Dept. 406, New York City 7.

40% PROFIT. Powermowers—$99.50. Big demand. Farm Products, M-2018, Excelsior Springs, Mo.

SELL famous $1 "Fire-Killer" extinguisher with bracket, wholesale or direct; exclusive territory. "Fire-Killer," Syracuse 1, N. Y.

AGENTS Wanted for our Slot Machines and coin operated amusement games in every town and community. Sell to clubs and homes, or start a route. Webb Distributing Co., Dept. P40, 6 So. Kedzie Ave., Chicago 12, Ill.

LATEX Balloons four collars samples 25c. Rubber Sundries and razor blades. Full time and side line salesmen wanted. Lytle Supply Co., Ave. 6, Fredericksburg, Ohio.

INFORMATION — Wholesale supply sources. Moneymaking plans. Increase your income. Write Reynard Station, Smithfield 3, Ohio.

FREE Sample—Nameplates, for homes, offices. Whitney Nameplates, Oakville, Conn.

MEN'S dress, sport shirts. Women's house dresses. Liberal commissions. Free selling outfit. Jarod Manufacturing Corporation, Rockville Centre 3, N. Y.

EVERY housewife a prospect for Automatic Speedi-Waxer. Send for details two big profit sales plans. Darby Corporation, Dept. 68, 241 Centre St., New York 13, N. Y.

NEW exclusive Xmas photo greeting cards, amazing value, big profits, approval samples. Spooner Greetings, 115 Chauncy, Boston, Mass.

POPULAR SCIENCE OPPORTUNITIES

SILVER plating liquid (NuSilver). Anyone can apply with cloth. Gives genuine gleaming silver finish. Renews silverplated ware, articles, pieces. Silverplates brass, copper. Distributors. Salesmen, agents wanted. NuProcess Products, Aurora, Ill.

NEW! Terrific! Gold plated ball pen-Cigarette lighter combination. Retails $1.00. Sample 75c; also new—retractable Ball pen at amazingly low price; 37½c each in dozen lots. Sample 50c. Write for literature. Sampa Co., Dept. E, 1120 Brighton Beach Ave., Brooklyn 24, N. Y.

BUY thousands of nationally advertised products direct from manufacturers. Write for "Buy Direct and Save." Consumers Ass'n, 287-B Lebanon Ave., Mt. Lebanon, Pa.

WOULD you pay 3%—first $350 made? Color-illustrated book "505 Odd Successful Enterprises" free! Proven! Work at home, office. Expect something odd! Pacific, Oceanside, California.

IMMEDIATE cash! Our magnificent plastic front Hardwood Photo Plaques bring quick profitable orders. Gotham Products, Box 5427a, Philadelphia 43, Pa.

MAKE sensational profits! New, sell-on-sight Plastic Line: Tablecloths, aprons; many other splendid fast-selling items, novelties. Postal brings free details, special deals. Hurry! Royalty, Box L-748, Passaic, N. J.

SELL Dental-Stero the amazing new toothbrush holder and sterilizer with nylon toothbrush. Complete package sells for only 75c. Your cost per dozen $4.00—net profit on 1 dozen—$5.00. Every home can use two to five or more. Big profits! Send $1.00 today for 2 sample outfits or write for more details. Dental-Stero Company, 3908 Secor Road, Toledo 6, Ohio.

MAKE $20.00 a day selling big value stay-polished solid brass name plates for doors; other easy sellers. Write today. Hubstamp, 357-B Congress, Boston, Mass.

POSITIVELY new. Virgin territories open. Distributors needed. Get in on fast moving reversible neckties. Retail $1.50. Sample. Sales setup $1.50. Farrell Company, 1377 Galbraith, Cincinnati 31, Ohio.

MAKE money fast! Sell Christmas cards to friends, neighbors, others. Big variety etchings, religious, 50 for $1.00, wrappings, stationery. New $1.25 line "Little ones." Flower box, plastic Frosteds, Saints 'n' Sinners. Special offers, bonus. Fund raising opportunity for individuals, clubs, churches, schools. Mail postal today for feature 21 card $1.00 Christmas assortment on approval. Hedenkamp, 343 Broadway, Dept. T-43, New York 13.

SELL cosmetics. Attractive containers. LaDien Grenard, 913 Main, Kansas City 6, Missouri.

DISTRIBUTE polishes, disinfectants, household products. McBride Products, 916 Walnut, Kansas City 6, Missouri.

63 HIGHGRADE SALESMEN

BIG Money Taking Orders: Shirts, Ties, Sox, Pants, Jackets, sweaters, shoes, uniforms, etc. Sales equipment free. Experience unnecessary. Nimrod, 4922-AV Lincoln, Chicago.

BRAND New! Revolutionary Products! Salesmen make $10,000 yearly selling one complete lighting line. "Neo-Glo" Fluorescent changeable message sign replacing neon. "All-Lite" table lamp using upright fluorescent tube, spectacular "Circline" fixtures using circular tube. Verticals, Dual-Rays, Pin-Up Lamps, a complete line of fluorescent and incandescent fixtures covering every commercial, industrial, residential need. A triple sales plan insures your success whether you choose selling dealers, direct, straight commission or distributorship on our capital. Get set now with our growing progressive organization. To get you started, we will send a beautifully illustrated catalog showing over 200 profitable, salestested styles and models. Order blanks, sales helps, everything needed to start at once included. It costs you nothing. Rush name quickly—Today—and start making real money. Rose Company, 539 KK South Franklin, Chicago, Illinois.

START your own business on our capital. Always your own boss. Hundreds average $6,000 to $25,000 annual Sales year after year. We supply stocks, equipment on credit. 200 home necessities. Selling experience unnecessary to start. Wonderful opportunity to own pleasant, profitable business backed by world-wide industry. Write Rawleigh's, Dept. H-U-PSC, Freeport, Ill.

SALESMEN. Earn $100.00 weekly, selling only six pair shoes daily. Commission and bonus. Wide variety for men, women, children. No investment. Experience unnecessary. Tanners Shoes, 301 Boston, Mass.

ALL kinds American, Swiss watches, new and used; retail $3.65—$345.00; profit 33⅓% up; show our catalogue, get orders. Brookins, B-1975CH, Little Rock, Ark.

67 EDUCATIONAL AND INSTRUCTION

HAVE your own office! Many earn up to $5,000-$15,000 Annually. Learn credit-collection agency business by home study course. Experience unnecessary. Write for Free bulletin. No obligation. Franklin Credit School, Dept. 203-H, Roanoke 7, Va.

BOOKKEEPERS! Increase your earnings! Operate your own simplified "Dollar-A-Week" Bookkeeping and Tax Service. Full or Spare time. Details Free. No obligation. Ellis, Box 203, Cedar Grove, North Carolina.

NURSES' Training School. Make up to $30-$40 week as a trained practical nurse! Learn quickly at home. Booklet free. Chicago School of Nursing, Dept. M-8, Chicago.

GET good jobs by learning free hand technical sketching. Learn with or without instruments. No talent needed. Free lesson. Acme, 1413 Butler, Easton 5, Penna.

SPEED and skill in radio code to qualify for amateur or commercial Radiotelegraph license. Learn at home with the famous Candler System used to train radiotelegraph experts and champions. Good pay or fascinating and profitable hobby. Free Book. Candler, Dept. 6-J, Box 928, Denver, Colorado.

FOR an extremely profitable lifetime business operate a Collection Agency—Credit Bureau. Easily learned. Free folder. Cole & Associates, Syracuse 2, N. Y.

BECOME a Doctor of Psychology or Metaphysics. Teach secret of contentment, happiness. Win degree of PsD. or MsD. Solve mental worries. Free book. College of Universal Truth, 5153-K N. Clark, Chicago.

PIANO tuners are in demand making big money. Learn piano tuning at home. Write Evansville School of Piano Tuning, Dept. C, 714 S.E. Second Street, Evansville, Ind.

U. S. GOV'T jobs! Big starting pay. Security. Men-women. Qualify now for next examinations. 40-page book—Sample lessons—Details Free. Write Franklin Institute, Dept. E22, Rochester, N. Y.

LEARN Dental technician trade. Ten simple lessons $5.00. Grant Laboratory, R, Los Angeles 14, Calif.

SUPERMEMORY makes data stick like burrs! Write Thor Books, CS-8, Box 1210, Chicago.

LEARN Piano Tuning. Prepare for Career in fascinating profession. $5,000 year easily earned. Real security, pleasant easy work. No profession Paying so well can be mastered so quickly. Natural Aptitude, desire to get ahead chief requirements. Prospectus and full information on request. Harmony School of Piano Tuning, Box 582, Harrisburg, Pa.

LEARN typewriter repairing under G.I. Bill. Adding Machine and Calculator courses available. For information write Dept. PS-8, Capitol School of Typewriter Mechanics, 1328 New York Avenue, N.W., Washington, D. C.

PRACTICAL plastics, fabrication—internal carving. New classes now forming. Approved G.I. Bill PL 346 & 16. Write Dept. PS, Enterprise School of Plastics, 81 Willoughby Street, Brooklyn 1, N. Y.

USED Correspondence courses and educational books. Bought, sold, rented, catalog Free. Educational Exchange, Summerville, Ga.

MEDICAL Laboratory Technicians in great demand. We train you in your own home, in your spare time. Also home study course in General Chemistry. Catalogue free. Imperial Technical Institute, Box 973-S, Austin, Texas.

AMAZE others. Add columns instantly. Add faster than adding machine. Free details. Maths Institute, Box 463, Nashville 2, Tenn.

69 CONTESTS

$1,000,000 FREE—Contests—Yearly. Win fortune. Winners prepare your entries—lowest cost. Research, 13 Earl Street, Red Bank, N. J.

70 LANGUAGE OUTFITS

LINGUAPHONE Makes Languages Easy at home. Learn to speak Spanish, Portuguese, Italian, French, German, Russian, by quick, easy Linguaphone conversational method. Save time, work, money. Linguaphone Correspondence Courses are available to veterans under G.I. Bill of Rights. Send for free book. State if G.I. Linguaphone Institute, 54 RCA Bldg., New York 20, N. Y.

72 AUTHORS SERVICE

I WANT New Writers to cash hundreds of checks for $1 to $100, offered each month. The easiest way to write for pay. No previous experience necessary. Send for Free details. No obligation. Saunders M. Cummings, 467-S Independence Bldg., Colorado Springs, Colo.

MANUSCRIPTS professionally rewritten for publication. Send manuscripts. Free examination-quotation. Renseb, 30 Church, N. Y. 7, N. Y.

74 CARTOONING, SIGN PAINTING, DRAWING AIDS

"HOW to make money with simple cartoons". A book everyone who likes to draw should have. It is free; no obligation. Simply address Cartoonists' Exchange, Dept. 198, Pleasant Hill, Ohio.

9 ALPHABET 3 Numeral Pattern Sets and Catalog $1.00. Sign Letter Distributors, P. O. Box 101, Mineola, N. Y.

SIGNS made easily. Instructions and ten sets modern alphabets, numerals, patterns. Sizes up to eight inches. All for $1.00. Co-operative Business, 7 West Madison, Chicago (2).

SIGN painting taught at home by an old master. Ben Kerns, Box 812, Greenville, S. C.

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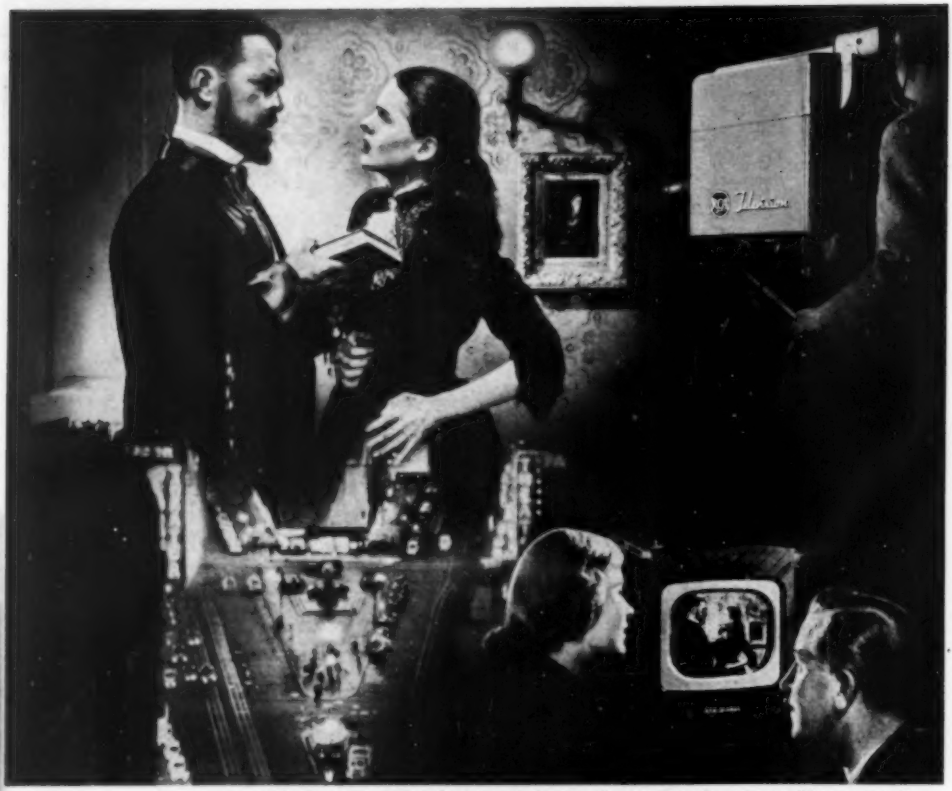
You can see that Vincent J. Schaefer, D. Sc., and Mister Schaefer, first class machinist, are of one and the same mind in believing that the scientist and the good workman have much in common.

Perry Gilkeson



Great drama comes to television in NBC telecasts of Theatre Guild presentations.

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Light Stopped . . . This picture—uninteresting at first glance—is one of the most important photographs ever taken: the first published portrait of a ray of light stopped in its tracks. Each white dot is the reflection of the same beam of light in one of a series of mirrors spaced along an inclined board (inset). The lower dot is about 10 feet from the camera; the upper one, 20 feet. The 10 feet between them is the distance the light—going a billion feet a second—traveled during the time the shutter was open: 1/100,000,000 of a second. This world's-record wink was attained by Navy scientists at Pasadena, Calif., with a Kerr-cell shutter (PS, July '48, p. 136) attached to a Kodak 35 Ⓣ.

What Can Our

Boss of the big bombers, Gen. George C. Kenney heads the Strategic Air Command. A veteran of the Pacific air war, he is an old hand at the business of long-range heavy bombardment.

Bombers Do Now?

America's foremost authority on strategic air power tells how amazingly bombing has changed since World War II.

An interview with General Kenney

By Herbert Johansen

IT TOOK the United States and its allies a long time to bomb the will and ability to fight out of Germany and Japan. Tens of thousands of planes and advanced bases all over the world were needed.

You'll never see anything like that again. A few hundred planes will suffice the next time. They will make fewer raids, taking off from fields in Texas, New Mexico, North Dakota, and Washington, rather than from bases in England and the Marianas.

Taking a B-29 out of moth balls

They will fly farther, but they will not tote so many tons of bombs. One reason is that the atom bomb knocks out whatever it hits for keeps. Another is that there won't be time enough for island hopping and base building.

These are the views of America's leading authority on this subject, Gen. George C. Kenney, head of the Strategic Air Command. He is a tough little man with a brush haircut and a square, leather-wrinkled face. He has been in the long-range bombardment business a long time. He fought for air power with Gen. "Billy" Mitchell back in the lean days. He sold General MacArthur on air power and, by his use of it, he undoubtedly shortened the war in the Pacific.

Two world globes flanked his desk when I interviewed him recently at Andrews Field, Md. One of them is calibrated to give global distances at a glance—from anywhere in the United States to anywhere anywhere. The other, a larger model, reminded me of one I had seen in his office in Brisbane, Australia, in 1944. Then as now Kenney made frequent trips to the globe, drawing a line with his finger to stress a point.

It's Kenney's job to be ready for whatever might come. "Never again," he declared, "will we bat down one war factory after another, one industry after another, utilities, communications, and so on." Grim as the prospect is, we would, on provocation, send our atom-armed bombers for a blanket attack on the enemy's centers of industry and population, stunning him, paralyzing him.

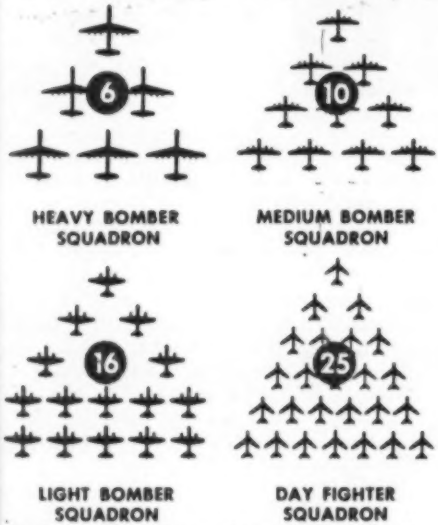
"That's what an enemy would do," Kenney is convinced. "If we are attacked, it won't be with just one bomb. It will be a slug-'em-out attack . . . A study of wars throughout history has taught us the brutal fact that, regardless of other factors, a decimation of population means almost certain defeat. Any enemy who might attack us knows that. And that's why we've got to be ready to bat back with a more powerful blow—shoot 'em on the rise.

"If we don't, we won't be standing in lines to buy nylons. We'll be standing in lines to live—if there are doctors and nurses left to jab our shriveled arms with an injection of some antidote for radioactivity that we haven't yet discovered."

Strategic bombardment in World War II depended on how far we could go and still carry a profitable bomb load. But today, strategic bombing authorities are concerned with only one bomb load—the atom bomb.

The atomic bomb gives a single plane the

The new Superfortress, Boeing's B-50, looks like its predecessor, the B-29, but has more power and range. For concentration of firepower, one man can control all five gun turrets.



In the new Air Force, three squadrons of the strengths shown above compose a group. In World War II, a heavy bomber group had 48 planes; for the atomic age, this has been reduced to 18. Under the 70-group Air Force setup there will be 21 heavy bomber groups, 5 light bomber groups, 22 fighter groups, 3 all-weather fighter groups, 4 tactical reconnaisance groups, 5 long-range reconnaisance groups, 10 troop-carrier groups, plus 22 separate squadrons such as liaison and rescue. Aircraft required: 6,869. Besides these, there will be 27 National Guard groups and 34 Air Reserve groups.

destructive power of 1,000 planes loaded with old-fashioned bombs. So even the 70-group Air Force you've been reading about in the newspapers will have only about 700 very heavy bombers, as compared with 14,000 used by the U. S. Army Air Forces and the RAF in the European Theater alone.

Right now, we have a bomber with greater range than any plane has yet flown in combat—ready to take off in a matter of hours. It isn't a new 20,000-, 15,000-, or even 10,000-mile bomber. It has neither jets nor rockets. It's the B-29 that delivered the A bomb to Nagasaki and Hiroshima.

"Nothing new has been added to this longer-range B-29," General Kenney explained, "except more efficient flying, squeezing every mile out of its engines and fuel load—a system of flying called cruise control."

Bombing America's most probable enemy with B-29s would entail one-way flights, but the airmen would figure on landing in friendly or neutral territory. We have several thousand B-29s in mothballs—possibly enough for 10 months of war.

We have other bombers with greater built-in range than the B-29, but they are not yet in mass production. Such a plane is the B-50. It looks like the B-29, but inside design changes and improved performance make it a 75 percent new plane. Its top

speed is around the 400-m.p.h. mark. The B-50's range, with cruise control, will undoubtedly exceed 6,000 miles—but just how much remains to be seen. Supercharger trouble and a few other "bugs" remain to be ironed out.

Another long ranger is Consolidated-Vultee's giant B-36. It has flown 8,000 miles with a dummy bomb load of about five tons. That flight was equivalent to a round trip between Alaska and Moscow. Kenney believes that its full gross load can be increased another 25 tons. That would make it a 10,000-mile bomber. But the 139-ton weight of the B-36 doesn't exactly fit in with his plans.

When asked about a 15,000- or 25,000-mile bomber, Kenney said he didn't want it. He considers the B-36 the last of the big reciprocating-engine, propeller-driven bombers. He doesn't want more range if it means making planes bigger and heavier.

Biggest of the bombers, the B-36 was designed to carry five tons of bombs for 10,000 miles.

"Propellered aircraft undoubtedly could be developed to give a range of 25,000 miles," he pointed out, "but with increased range, the speed, in relation to jet jobs, decreases to a point where the bomber would be a sitting duck for jet fighters or antiaircraft fire. Rather than sacrifice the advantage of speed, I would add the extra range I need by refueling in flight."

He is convinced that in-flight refueling of combat planes is a certainty. So his ideal bomber would have a range of about 7,000 miles built in, and a speed of between 500 and 600 miles per hour. It would be either a turboprop or jet-powered job.

High-efficiency turbojets and ram-jets can give speeds 'way up in the supersonic regions, but at present range is limited. General Kenney, while discussing the problem, picked up a model of the sweptback-wing Boeing XB-47 six-engine jet bomber.

"This, or something like it," he said, "may be the answer to speed and range."

The XB-47 can do around 600 m.p.h. and, although still experimental, has a range reported to be around 3,000 miles.

The Lockheed-designed XJ-37 turbojet engine (PS, June '48, p. 144) may solve the problem, licking the high fuel consumption of other engines of this type. Its high thermal efficiency may give jet bombers the long range of their reciprocating-engine brothers.

Another solution may be nuclear energy for fuel. But however we get it, long range will be as essential to the next air war as the atomic bomb. Outlying bases, such as Stephensville, Newfoundland, or Mile 26, near Fairbanks, Alaska, will be no more than fighter-protected fuel dumps. A quick landing there to load up with gas, and then on across the North Pole—to come back or not, depending on range available at the time.

The atom bombs will be kept in the safest places as long as possible. So our very heavy, long-range bombers will take off from bases in the heart of the United States. Right now, Strategic Air Command headquarters is being moved from Andrews Field, Maryland, to Offutt Field, Nebraska.

General Kenney's boys have dreamed up an ingenious way of greatly increasing the amount of auxiliary gas that can be carried economically—but he'd rather not talk about it right now. So that leaves cruise control and in-flight refueling (PS, Jan. '47, p. 82).

The father of cruise control is Col. C. S. "Bill" Irvine of *Pacusan Dreamboat* fame (PS, Dec. '46, p. 91). The trick is to make each part of the engines carry its full share of the load, to make it work evenly, smoothly, and at top efficiency. During the war, "engine flying" increased the bomb load from three and a half tons to 10 tons.

The XB-47 has 6 jet engines, 4 in pairs and one near each wing tip. It can carry the A bomb.

Ways to do it still better have been found since then. Even the best tuned-up carburetor system, for example, is inefficient because of its uneven distribution of fuel. The answer was fuel injection, which gives each cylinder exactly the same amount of gas.

Today there is no guesswork in flying the B-29, and there won't be in flying the B-50. As the flight engineer watches electronic fuel gauges, flow meters, and other instru-

ments, he knows exactly what is going on in the engines, whose spark-plug gaps have been adjusted to 1/10,000 inch. Torque meters tell the exact horsepower each engine is pulling. If there is the slightest deviation from the flight cruise plan, a correction is made. With no margin of error allowed, the word precision has the same meaning in cruise-control flying that it has in the laboratory of a microchemist.

The other main factor in mile-stretching is mid-air refueling. It is one of Kenney's top-priority projects. The British have operated aerial gas stations over both the South and North Atlantic, using a B-24 as the tanker and a Lancaster cargo plane as the receiver. And as this article was being written, a simplified version of the British equipment was being tested over the North Atlantic at altitudes above 12,000 feet, with contact between the planes made by radar.

Since the B-29 is pressurized and the air is extremely cold at high altitudes, manual adjustments outside the plane are impossible. So the system has to be fully automatic. The two planes fly about 100 feet apart, and gas is transferred at a rate of about 100 gallons a minute. Because the planes have to operate as Siamese twins, Kenney plans to use two of the same type: that is, a B-29 tanker would fuel a B-29 bomber.

Where would we refuel our bombers? General Kenney walked over to one of the two globes and pointed to the tip of the always-on-top northern hemisphere.

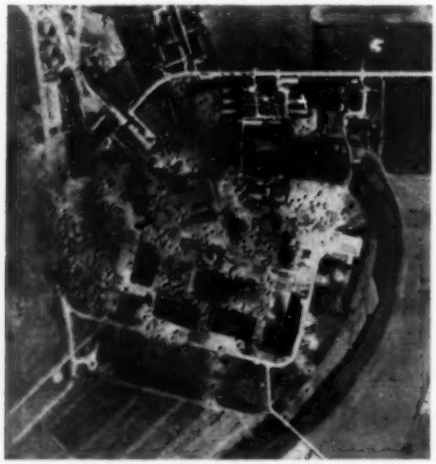
"If we get into trouble again," he said, "the attack will probably come over the shortest air routes from the European-Asiatic land mass across the North Polar basin. And that's where I'd refuel—right over the North Polar basin, north of the Arctic Circle."

Fighter escort for long-range strategic bombing missions is a moot question. There is no fighter today that has enough range. An escort plane with a radius of even 5,000 miles would carry turreted armament. To protect the bomber, and itself, it would remain in formation, firing on any attackers that came within range. Such a fighter would have to be almost as big as the bomber it defended.

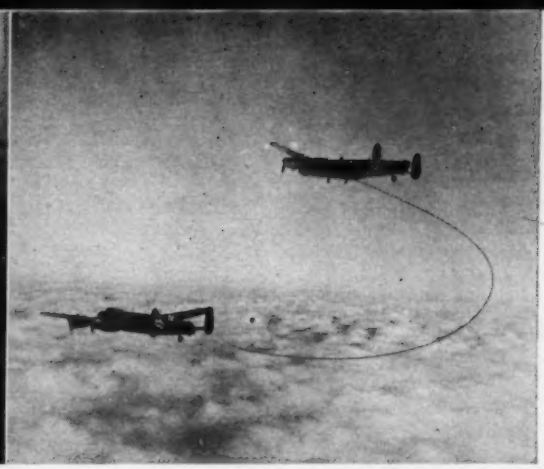
Then there is the kangaroo approach, with the bombers carrying their own fighter escort. Already under test is the McDonnell XP-85 parasite fighter, designed to be nestled inside the bomb bay of the giant B-36. It would be released in case of attack and picked up later. But General Kenney isn't too keen about the idea. "I'd use the added weight for gas," he said.

There'll be no fighter escort in his book. Bombs will be dropped from 25,000 to 30,000 feet under cover of night or through clouds. The greater speed of jet bombers may make daylight bombing feasible. Those who shake their heads and point to the heavy losses of unescorted bombers in World War II might mull over a recent report that 10 of our continent-based B-29s made a mock attack on England. Of the 10 bomb-

One atom bomb, with the destructive power of 10,000 tons of TNT, did this on August 9, 1945, to Nagasaki, a city of more than 200,000.



A mass formation of bombers using ordinary bombs was needed to do this to a single Nazi factory. The photo shows 286 bomb craters.



Refueling in flight is the gimmick that will give extreme long range to our bombers. Above, right, is shown a photo of a British B-24 refueling a Lancaster. The detailed photo at left shows how the leader line caught by the receiver plane pulls in the fuel hose. U. S. method is a simplified version of this system, adapted for high-speed, high-altitude bombers.

Long, 10,000-plus-foot concrete runways will not be necessary with the track-gear shown above. Pictured at right above is the gear installed on a 54,000-lb. Fairchild C-82 Packet.

ers, six were detected, but only two of the six were "shot down" by RAF jet fighters. In experiments conducted by our First Fighter Group, P-80 jet fighters have encountered difficulties in making interception attacks on individual B-29s coming over at extremely high altitudes

If we send our bombers out on serious business again, they will not go in mass formations to make a meaty target for interceptors. We would probably not assign more than six bombers to a target, and they would make the bomb run from different directions.

There may be few places in friendly territory where the heavyweights can land the way they would at home. But Kenney says we may not need such bases. "We may use track-type landing gear," he explains.

Fairchild has been experimenting with this idea for some time, using a gear made by Firestone. Tractor landing gear was recently installed and successfully tried on a C-82 Packet. It is in the works for the B-29, the B-50, and even the B-36.

With this gear, which on very large aircraft saves weight, our biggest bombers will be able to take off and land from almost any reasonably flat area: prairie, desert, tundra, beach, snowfield. Kenney points out that even ice caps could become emergency bases if we sent a glider in with a bulldozer to smooth out the hummocks.

"We've got to have this and a lot more," Kenney emphasized. "Equality with any enemy isn't enough. If we let the other guy get ahead of us, he'll drop something else along with the pay-off A bomb—it will be a fountain pen for us to sign the dictated terms of bondage." END

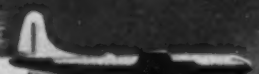
For a pictorial summary of strategic bombing, turn to the next page.

B-29

Boeing's Superfortress plus the atom bomb is our weapon of long-range bombardment today; if trouble should come, we have a reserve of 2,000 Superforts in storage.

BASIC RANGE—3,200 MI.

WITH CRUISE CONTROL—5,700 MI.



B-50

At first glance it takes an expert to tell the B-50 from the B-29. The 50's tail is six feet higher, and wing area is 25 square feet greater. Engines have 3,500 hp.

BASIC RANGE—5,000 MI.

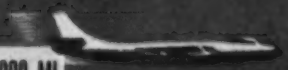
WITH CRUISE CONTROL—6,500 MI.

B-36

Consolidated-Vultee's huge bomber has six pusher [illegible]

BASIC RANGE—8,300 MI.

WITH [illegible]DED FUEL—10,000 MI.



XB-47

[illegible] is still [illegible] about the jet entry for long [illegible] development will [illegible]. General Ken[illegible] the power [illegible] week, six engine Bo[illegible]

BASIC RANGE—3,000 MI.

MORE EFFICIENT JET ENGINE— ?

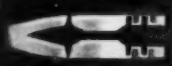
?

How Far Could Our Bombers Go?

THE B-29 Superfortress, a veteran of the last war, is still the best we have today; it now has a range close to 6,000 miles. Bombers with greater range, like the B-50 and the B-36, are flying, but are not in mass production. Both are still being improved as "bugs" are eliminated. Under pressure of war, they could go into immediate production. And, like the B-29 in World War II, they could be flown from assembly line to front line, getting their service tests in actual combat. Cruise control – more efficient flying – already has almost doubled bomber range, and in-flight refueling will probably make if unnecessary to build bigger and heavier bombardment planes to gain greater range. The non-stop, globe-girdling bomber died on the drawing bo

Engines vs. Distance

COMPOUND-RECIPROCATING: 20,000 miles.



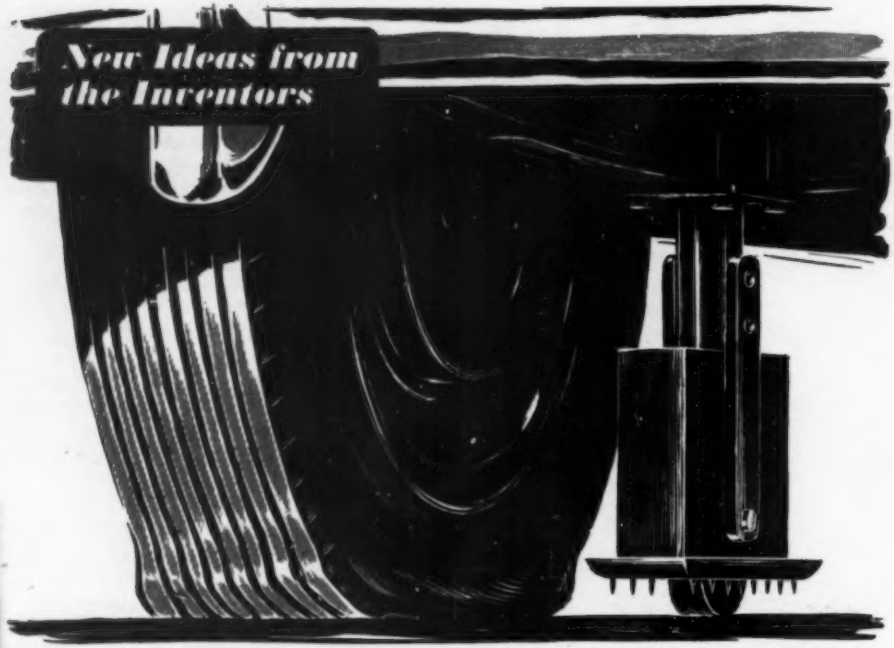
TURBOPROP: 5,000-10,000 miles at high speeds.

RECIPROCATING: 5,000-10,000 miles at medium speeds.

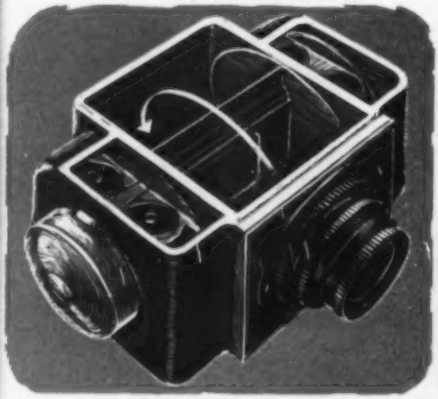
TURBOJET: 1,000-5,000 miles.

RAMJET: Up to 1,000 miles.

The above range figures are approximations, but give an idea of the relative scope of operation of current and future aircraft powerplants. Jet fighter aircraft make it imperative that speed be built into our big bombers. Fuel economy – for range – therefore cannot be bought by too great a sacrifice of speed. Instead, range must be increased in other ways, such as by refueling in flight or by developing nuclear fuel.

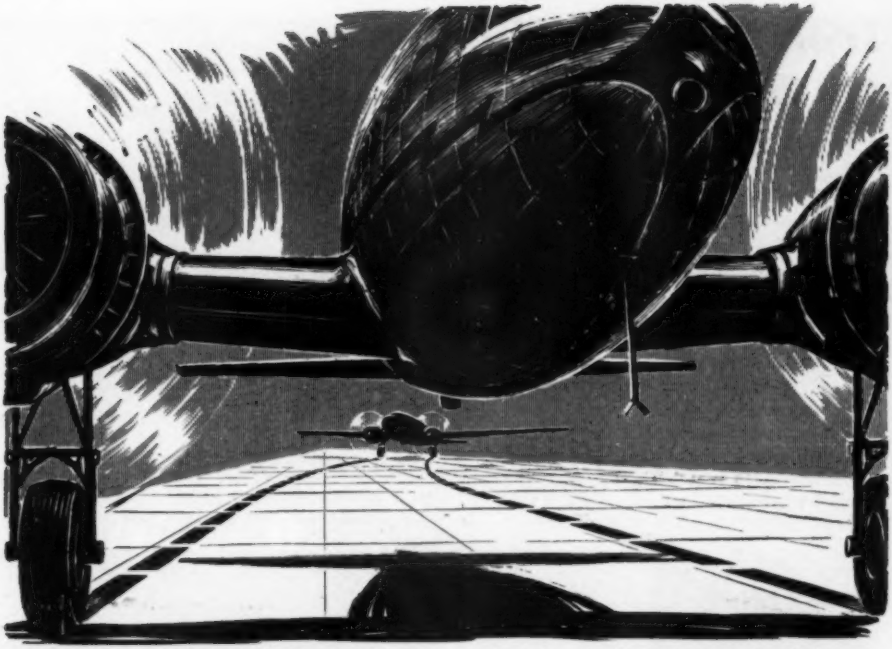


Jack Aids Blowouts, Skids. A small wheel in the bottom of this built-in, hydraulic auto jack is designed to act as a temporary support when a blowout occurs. When the jack is lowered further, the wheel recesses into the base, and the car is raised for easy tire-changing. A spiked plate on the bottom permits emergency use of the jack to stop skidding on ice. A. M. Sorrentino, of Brooklyn, N. Y., is the inventor.



Camera Holds Two Films. With this camera, you'd be able to take color or black-and-white pictures without stopping to change the film. Patented by W. D. Teague, of New York City, it holds two rolls of film back to back with a partition between. A knob on the side rotates the film holders to bring either film in front of lens.

Twister Joins Wire. To save wear and tear on the fingers, W. B. Mitchell, of Seattle, has patented a twister for joining two ends of wire. One wire is threaded through guides on the twister, while the second is hooked under a flange at one end. When the twister is turned, the flange winds the second wire around the first.



Brakes Straighten Plane. Newly patented auxiliary wheel brakes are designed to keep a plane from ground looping if it comes in for a landing at an angle to the runway. As the plane turns, sidethrust against the wheel on the outside of the turn forces it inward against a brake drum. This pivots the airplane on the braked wheel, bringing it back in a straight line. The inventor is H. L. McPherson, of Memphis.

Handle Bars Are Adjustable. By just tripping a finger release, a bicyclist could adjust these handle bars to the most efficient position for various speeds and terrain. Patented by M. Dufaux, of Geneva, Swit., they are meshed at the steering post by two gears, so each moves with the other. Once set, they lock at desired position.

Shaker Keeps Salt Dry. A ball valve in this novel salt shaker, invented by T. R. Duncan, of North Hollywood, seals it against moisture. The ball rests loosely over a funnel-shaped opening in the bottom and keeps it closed when the shaker is not in use. Shaking the container jiggles the ball, letting out a little salt with each shake.

Iron Horse Trims Its Own Hoofs

MOTORISTS aren't the only ones to worry about flat tires. Locomotives get them too. Their great driving wheels scream against the rails in starting, braking, and grinding around curves until flat spots develop.

That's why railroad men are interested in this new method of shaving them smooth again. It takes only half a day for what once was a five-day job in the shop. The wheels stay right on the locomotive, which itself serves as the lathe to trim them.

The method is called the Lidgerwood system, named for the company that makes the heavy-duty winch used to pull the iron horse while it trims its own hoofs.

Electric winch, anchored in concrete and powered by 75-hp. motor, reels in 1½-in. cable to tow locomotive along slightly inclined track in the Southern Pacific yards at Los Angeles.

Towing cable is looped over pulley mounted on a truck that couples to rear of the tender. When winch turns, locomotive is pulled backward up a special 900-ft. length of track at 1¼ m.p.h.

Inch-thick "razors" shave tread and flange of a worn tire to proper contour. They're used one after another (left to right) as winch pulls the locomotive 8 to 14 times along the track.

Cutting head, with slot for "razor," replaces brake shoe. Compressed air holds it against wheel. Tires are trimmed about once a year, after 40,000 to 200,000 miles of service.

Trimming takes up to a quarter of an inch of steel off tire. After 8 to 11 treatments have cut it from an original thickness of 3¾ in. down to 2¾ in., the worn tire must be replaced.

Getting Bugs Out of Jets

Maneuverability is a feature of the P-84. As shown above, it climbs steeply, doing 365 m.p.h. With a top speed of 600 m.p.h., the Thunderjet has a range of more than 1,000 miles and a ceiling of 40,000 feet.

"THE THUNDERJET is the sweetest plane I've ever flown," says Lt. Col. Lewis W. Chick, Jr., veteran combat fighter pilot and deputy commander of the 14th Fighter Group, Dow Air Force Base, Bangor, Maine. "And," he adds, "we're making it sweeter every day."

By that he means that with every hour of operational flying, his boys are ironing the bugs out of Republic's 600-m.p.h.-plus P-84 jet fighter. This is in addition to developing new fighter tactics, training jet pilots, creating a maintenance system . . . and, incidentally, guarding the northeastern approaches to the United States.

Close coordination is maintained between the fighter group and Republic's factory at Farmingdale, New York, so that the lessons learned by pilots in the sky and mechanics on the ground can be incorporated into better and safer P-84s. A priority project is a study of the most efficient use of rockets and bombs in addition to the plane's six, wing-hidden, 50-cal. machine guns.

The Thunderjet is really a nose and tail fitted over the powerful GE, Allison-built J-35 turbojet engine, developing 4,000 lb. of thrust. Here mechanics are shown stripping down an engine for overhaul after about 20 hours of flight.

How to Use an Abacus

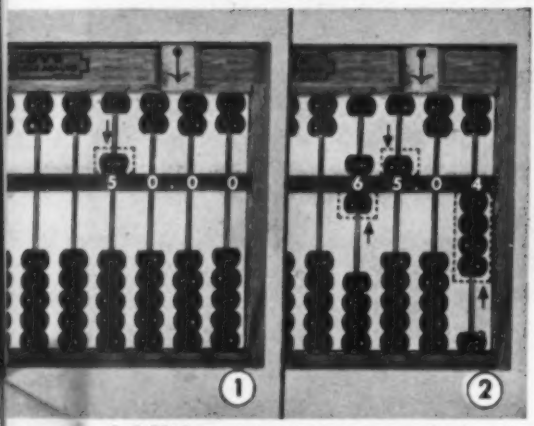
By W. D. Loy

Inventor and Manufacturer of Loy's Improved Chinese Calculator

EVER watch a Chinese shopkeeper figuring his accounts on an abacus? There's no good reason why you too can't use his simple arrangement of beads on wires. For the abacus is not only the world's oldest calculating device, but also the cheapest—and not half as hard to run as it looks.

Suppose you wanted to check the figures on your pay check with an abacus. These pictures of how John Doe re-figures his pay, step by step, show how you would do the adding, subtracting, multiplying, and dividing.

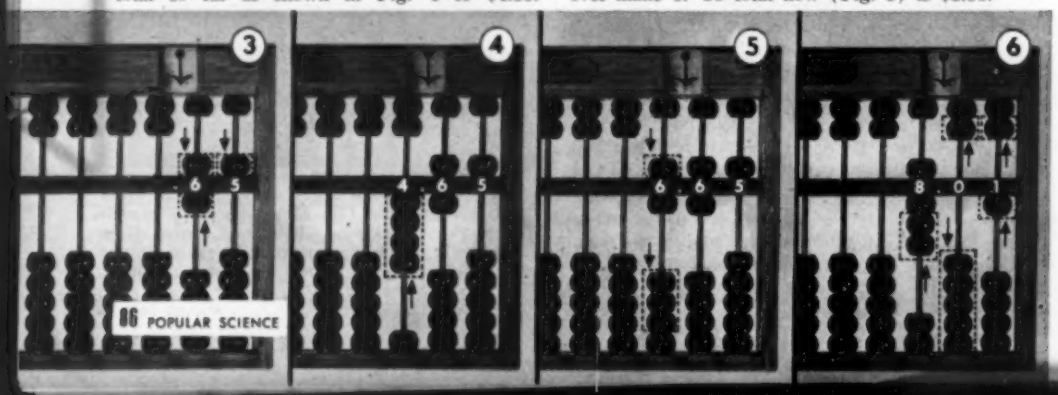
Each column of beads on the abacus represents a digit, and figures are read from left to right in the normal manner. Beads below the crossbar in each column have a value of 1 each; those above, 5. A column is clear—representing 0—when all its lower beads are pushed down, away from the crossbar, and both its upper beads are pushed up. A digit then is entered by sliding the required number of beads up or down to the crossbar.



Addition. John Doe starts pay-check problem with abacus cleared: all beads above crossbar pushed up, all below pushed down. Arrow between second and third columns from right marks decimal point. A top bead (5) in fourth column from right is pushed down (Figure 1) to enter on abacus his weekly wage: $50.00. To add overtime pay—$15.04—Doe pushes up four lower beads (1 each) in righthand column, pulls down an upper bead (5) in first column to left of decimal, pushes up a lower bead (1) in next column to left. Total (Fig. 2): $65.04.

To add up his deductions, Doe clears the abacus again. He sets the arrow between the second and third columns from the right, as before, to indicate the decimal point. Now he enters $.65, his social-security payment, by pulling down an upper bead in the right-hand column for the 5, then pulling down an upper bead (5) and pushing up a lower bead (1) in the next column to the left for the 6. The result is shown in Fig. 3. Next he adds $4.00, withheld for his Federal income tax, by pushing up four lower beads in the first column to the left of the decimal point. That gives him a total so far—as shown in Fig. 4—of $4.65.

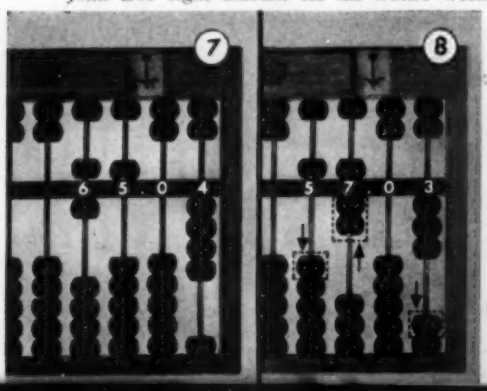
U. S. bond deduction of $2.00 is added by pulling down an upper bead (thus adding 5) and pushing down three lower beads (subtracting 3) in first dollars column. This gives a total (Fig. 5) of $6.65. To this Doe adds his hospitalization deduction of $1.36. New 6 plus old 5 in right-hand column make 11; so 1 has to be carried over into next column—just as in adding on paper—leaving 1 in the first column. In the second column, 3 plus 6 plus the 1 carried over add up to 10; so column is cleared, and 1 is carried over to third column. There 1 plus 6 plus the 1 carried over make 8. So total now (Fig. 6) is $8.01.

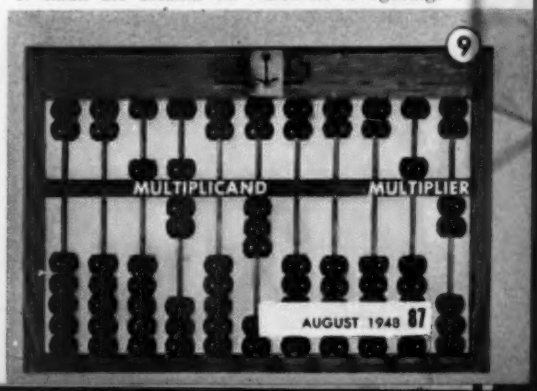


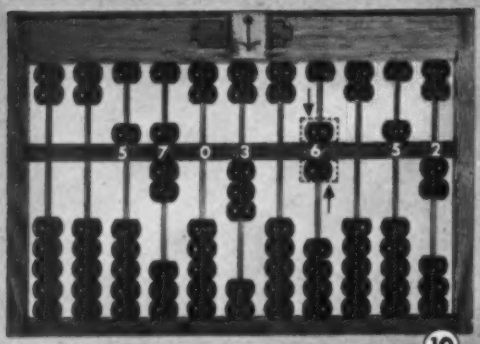
Chinese abacus has five beads below crossbar in each column, two above it. Japanese have one with single row of upper beads; other variations were used by ancient Egyptians, Greeks, and Romans. Author of this article invented sliding pointer to locate decimal point or mark column being used in multiplication or division. This model sells for $6.50, and can be purchased by mail from him at 1317 Rhode Island Ave., N. E., Washington, D. C.

Subtraction. Now Doe wants to subtract his deductions—$8.01—from his weekly pay. He clears the abacus, then enters on it (Fig. 7) his total pay of $65.04. Subtraction is, literally, taking away. To take $8.01 from $65.04, he first pulls down one lower bead in right-hand column. Zero from zero is zero; so second column is unchanged. Since he can't take 8 from third column—it has only 5 registered—he gets same result by adding two lower beads there and taking away one lower bead (representing 10) from fourth column. Answer—$57.03—shows (Fig. 8) that the company cashier paid John Doe right amount for his week's work.

Multiplication. Next Doe wants to find out how much he'll take home in a year if he keeps on earning at this rate. To get that, he must multiply $57.03—his weekly check—by 52 weeks in a year. He puts the multiplier, 52, on two right-hand columns (Fig. 9, below). The multiplicand, 5703, goes on any four columns to the left, leaving some space in the middle for figuring. Decimal is disregarded during the calculating and will be inserted later in answer, since its position doesn't change in figuring dollars and cents. The sliding arrow, no longer needed for decimal, will be used to mark the column on which he is figuring.

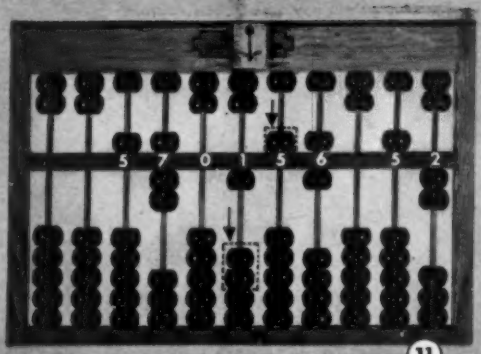






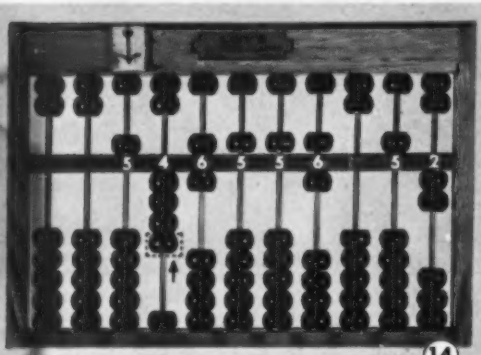
10

Multiplication starts from the right and is based on multiplying single digits, as on paper: 3 x 2 = 6. Products of right-hand digit of multiplier go as many columns to right of the digit being multiplied as there are digits in multiplier (52). Doe puts 6 two columns to right of 3.



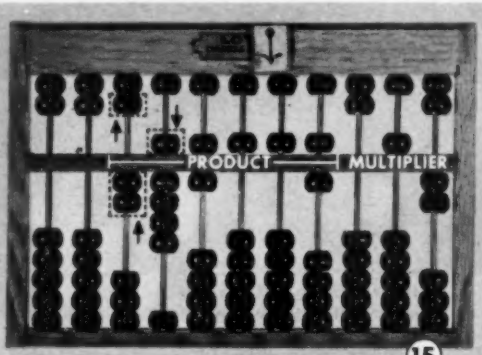
11

Next he multiplies 3 by 5. Since the 5 is one column to left of the 2 in the multiplier, its products go one column farther left. So Doe puts 15 (3 x 5) to left of his 6 (3 x 2). Because he has now multiplied 3 by both digits of 52, he can get rid of it to make room for the 15.



14

Arrow is moved to indicate that Doe now is working on the 5 column. He multiplies it by the right-hand digit—2—of the multiplier: 5 x 2 = 10. He adds the 10, again beginning two columns to right of the number being multiplied—5. This he does by adding 0 to that column and 1 in the next column to the left.



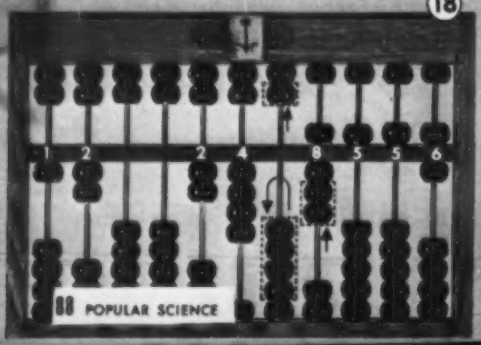
15

Final step: 5 x 5 = 25. As before when multiplying by the 5, product goes only one column to right of the number being multiplied. This finishes multiplication; Doe discards 5 in multiplicand and enters 25 by adding 2 under arrow and 5 to next column to right. Answer, with decimal, is his yearly take-home pay: $2,965.56.

Again (below) Doe divides by 12. It goes four times into 56—now the first two figures of dividend. He enters 4 in quotient, moves arrow over it, and subtracts 48 (4 x 12) from 56. He takes the 8 from right-hand column by adding 2 and subtracting 10 (one bead in next column to left). He then takes 4 from left-hand column.

Next step in Doe's division goes the same way: 12 into 85, now the first two figures in the dividend. It goes seven times. So he enters 7 in the quotient, and moves indicator over it. Then he subtracts 84 (7 x 12) from the 85. This leaves 1. So the three figures now remaining in the dividend, as shown below, are 156.

18



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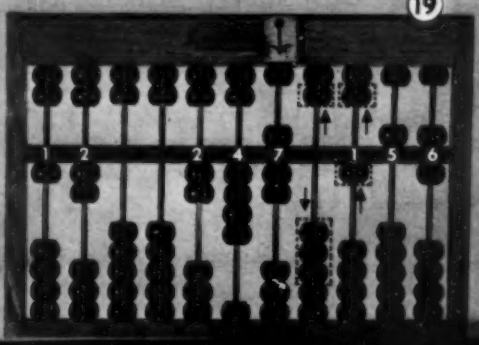
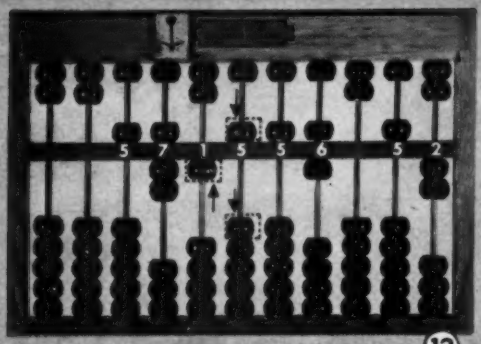
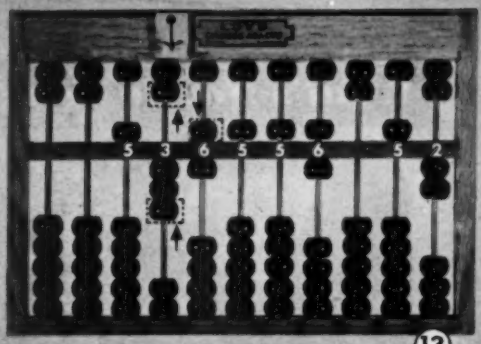




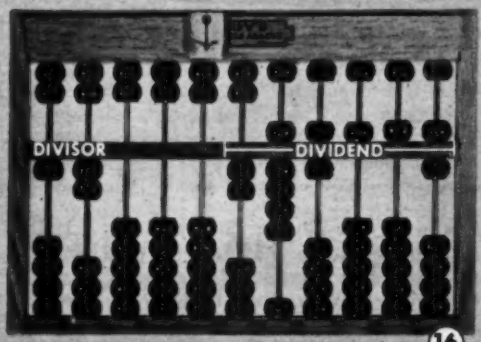
12

Skipping 0 in multiplicand, Doe sets arrow above 7. Again he multiplies: 7 x 2 = 14. He puts answer, as in first step, two columns to right of digit being multiplied—7. This he does by adding 15 (5 in second column to right of 7, 1 in next column to left) and taking away 1.



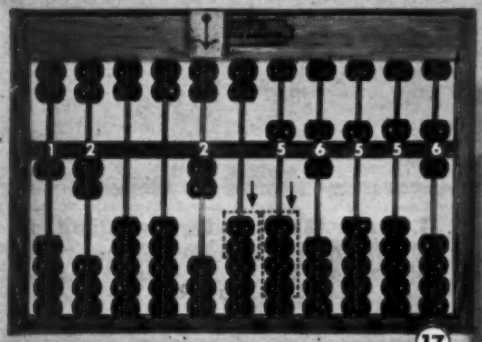
13

He then multiplies 7 by multiplier's left-hand digit (5). Again, product (35) goes a column farther left than when he was multiplying 7 by right-hand digit—that is, only one column to right of the 7 being multiplied. Finished multiplying 7, he discards it to enter the 35.



16

Division. John Doe wants to know, next, his average monthly income. To get it, he must divide his yearly total of $2,965.56 by 12 for the number of months in a year. He first clears the abacus. The divisor, 12, then is placed on the two left-hand columns. The dividend, 296556, goes on the six right-hand columns.



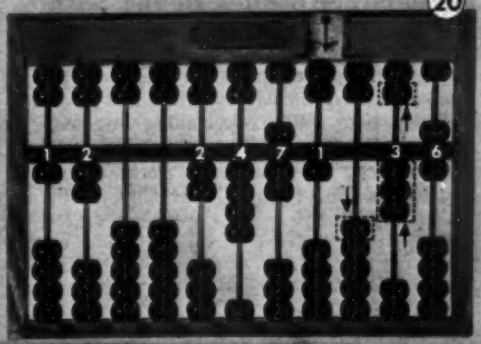
17

He starts dividing: 12 goes in 29 twice. So, in first column to left of dividend, he sets up a 2, first number of the quotient. Over it he places the indicator. He then subtracts 24 (2 x 12) from first two digits in dividend, 29, just as you do on paper. That leaves none in first column of dividend, 5 in second column.

Again he divides the first two figures of the dividend by 12, as before: 12 into 15 goes once. Doe puts a 1 on the end of the quotient, and moves arrow over it. Then, to subtract 12 from 15, he actually takes away 15 on abacus and adds 3. Leftover 3 and the 6 to right of it are now (below) last two figures in the dividend.

Problem is completed (below) by dividing 36 by 12. It goes three times even; so the two left-hand columns are cleared, and 3 is entered in quotient. Then, since the answer is in dollars and cents, the indicator is set two places from the right in the quotient. The final answer is John Doe's average monthly income: $247.13.

20



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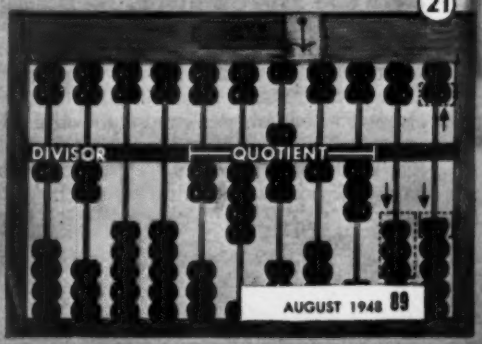
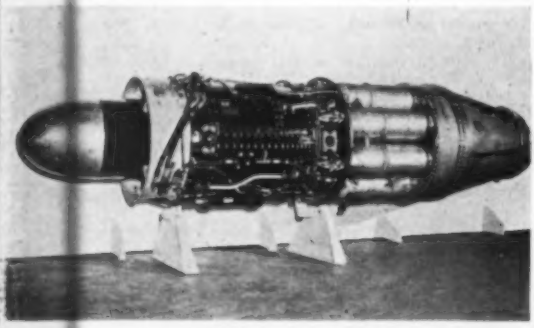


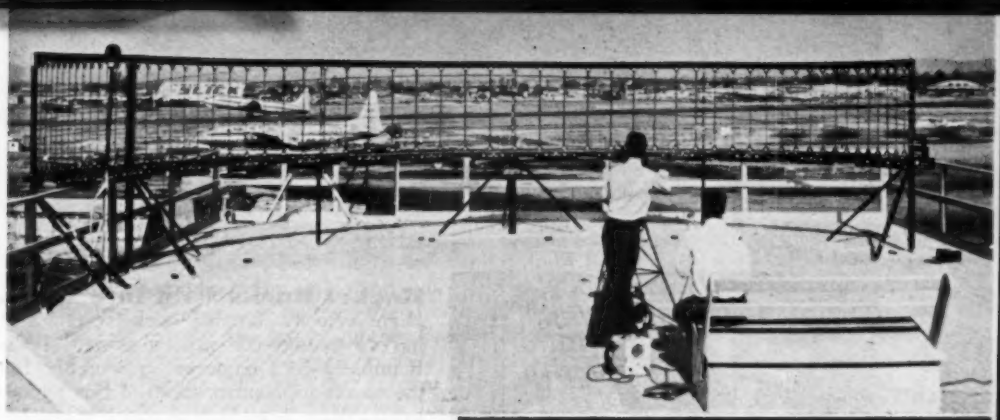
What's New in Aviation

Longer Hull, Safer Landing. The Martin XP5M-1 flying boat shown above will put to test a new, long afterbody hull. Extended to the extreme end of the plane, this is expected to permit safer landings in rough seas with less pitching and bouncing. It also will reduce normal take-off time and distance, since the long afterbody gives extra-clean planing. Built for the Navy, the XP5M-1 flies more than 200 m.p.h.

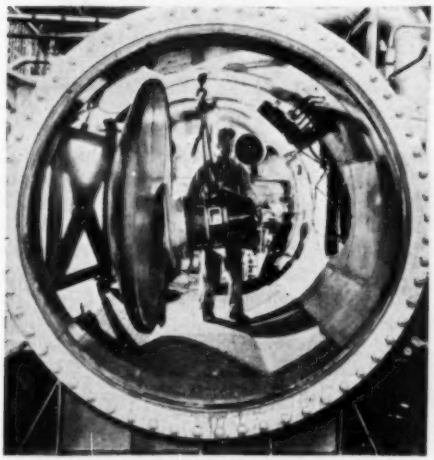


Jets Get More Power. The General Electric TG-190 (J-47) jet engine shown above weighs about the same as its predecessor, the TG-180 (J-35), but has 25 percent more power. With a thrust of 5,000 lb., it is claimed to be America's most powerful jet engine. The TG-190 has been installed in the "more than 650-m.p.h." F-86 Air Force jet fighter, and will soon power others.

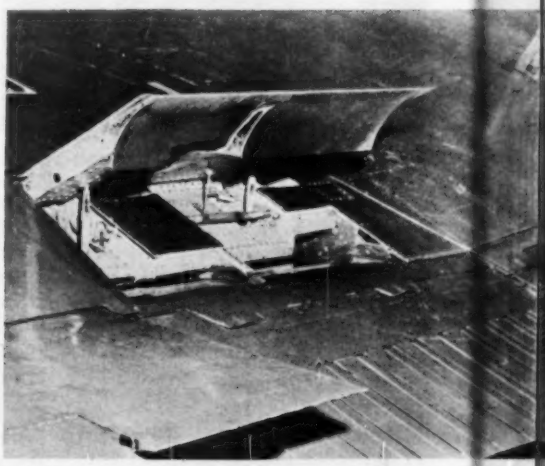
Feederliner Makes Debut. Seven passengers can fly comfortably in this new Aero Commander ⓕ. It is intended for service on routes feeding into main airlines. With a range of more than 1,000 miles, it is powered by two 190-hp. Lycoming engines; speed is 181 m.p.h. The tricycle landing gear retracts. The builder is Aero Design and Engineering Corp., Culver City, Calif.



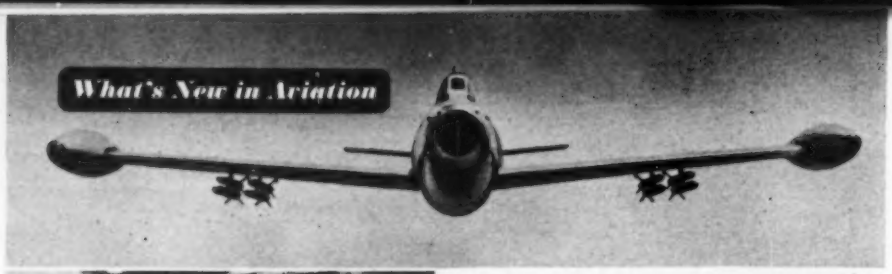
Camera Clicks Take-Off. Photo above shows how a motion-picture camera gives a mathematical determination of a test airplane's take-off and landing performance within 1/100 second. Set up behind a curved vertical and horizontal wire grid, the camera's 4¼-inch telescopic lens is focused on the airplane 1,800 to 2,000 feet away. The vertical wires mark off 100-foot sections of the runway; the horizontal wires indicate altitude in 25- and 50-foot sections. Movie frame at right records that a Lockheed Constitution has gained 50 feet of altitude after a run of about 2,900 feet.



Making Jets Better. This scale model of a jet-engine compressor will "climb" to altitudes up to 70,000 feet and be exposed to temperatures from 70° below zero to 150° above—without leaving the ground. These conditions will all be reproduced in the test chamber in which it is being installed above. The chamber is part of a new GE $25,000,000 laboratory at Lynn, Mass.



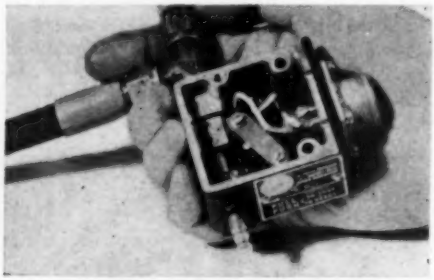
Spoilers Aid Aileron Control. The Martin-developed spoiler aileron pictured here gives the pilot extra control in banking without increasing the aileron surface. The spoilers are located inboard of the regular ailerons, just ahead of the flaps. In raised position, they help force the wings down in a turn. Spoilers on each wing operate independently of those on the other.



Rocket Racks Fold into Wing. High velocity aircraft rockets (HVAR) have increased the striking power of the Republic F-84 Thunderjet considerably—but the maximum combat speed of this famous fighter plane is as high as ever. When the rockets are fired, retracting mounts disappear into the wing, leaving no exterior obstructions to cut down speed.

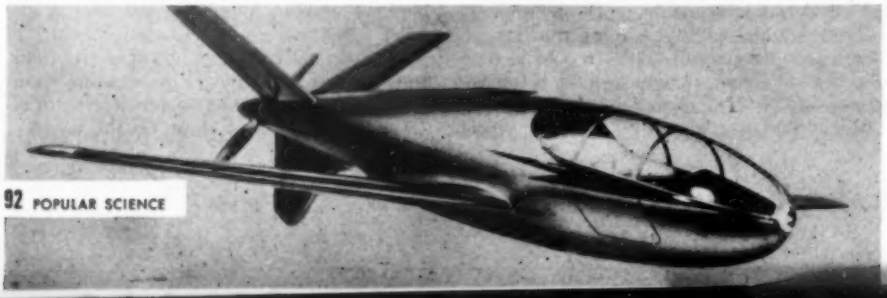
Four 140-pound rockets under each wing (see left and above) are mounted in pairs but fired individually by the pilot. The rockets have a velocity of over 950 m.p.h.—half again the speed of the plane, which also totes six .50-cal. machine guns.

Finds Fuel Level. This built-in fuel gauge makes it easy to see how much gas there is in an underwing fuel system. It is just pulled down and out of the fuel cell in the wing, as shown above on a Martin 2-0-2. When the upper end of the gauge reaches the fuel level inside tank, holes in its tip let gasoline drip through and out the bottom, and a mechanic takes a reading on a scale marked in 20-gal. units.



Fast Pressure Alarm. This switch lets a plane pilot know when the carbon dioxide in his fire-extinguishing system has discharged. The drop in the pressure of the gas activates a piston in the switch. This closes the circuit that turns on a warning light in the pilot's cockpit. The device, invented by L. J. Bordelon, Convair chief flight engineer, is made by Airite Products Co. of Los Angeles.

Plane Resembles Torpedo. This Planet Satellite Ⓣ is arranged like a ship. The 250-hp. Gypsy Queen engine is amidships, and the pusher propeller is in the stern, aft of the tail. This design is expected to reduce noise in the cabin of the British four seater as well as insure a smooth air flow over the magnesium-alloy frame. The Satellite Ⓣ is expected to cruise at 191 m.p.h. and have a top speed of 210 m.p.h.

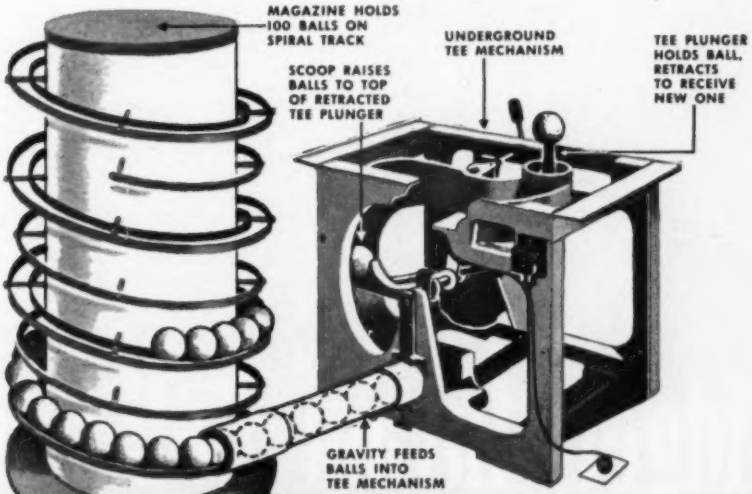


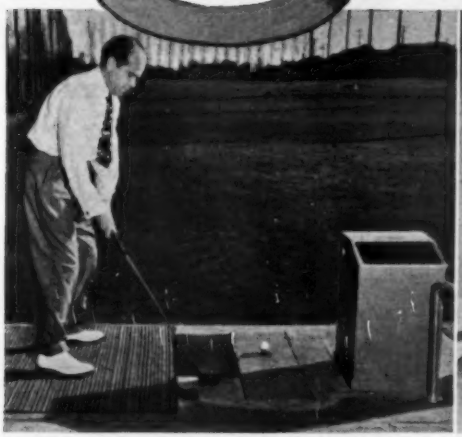
Electric Tee Helps Lazy Golfers

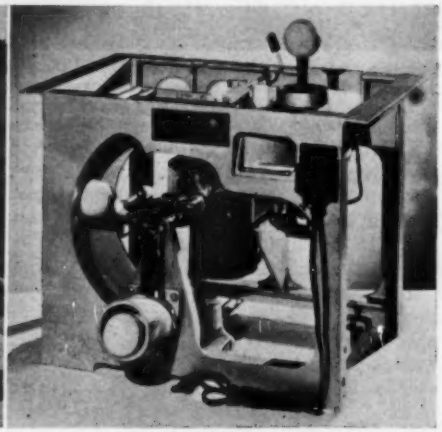
GOLF pro Joe Mozel has used his head to save his back—and the backs of all the duffers who spend hours just hitting balls for practice. He has invented a machine that automatically tees up golf balls, relieving practicing golfers of the bend-over-and-put-another-ball-on-the-tee routine. As fast as one ball can be hit away, another is placed on the tee, ready for the next shot.

The tee-er holds 100 balls on a spiral track, down which they roll by gravity to the tee mechanism below. Here a spoon, driven by an electric motor, lifts them up, one at a time, and places them on the tee.

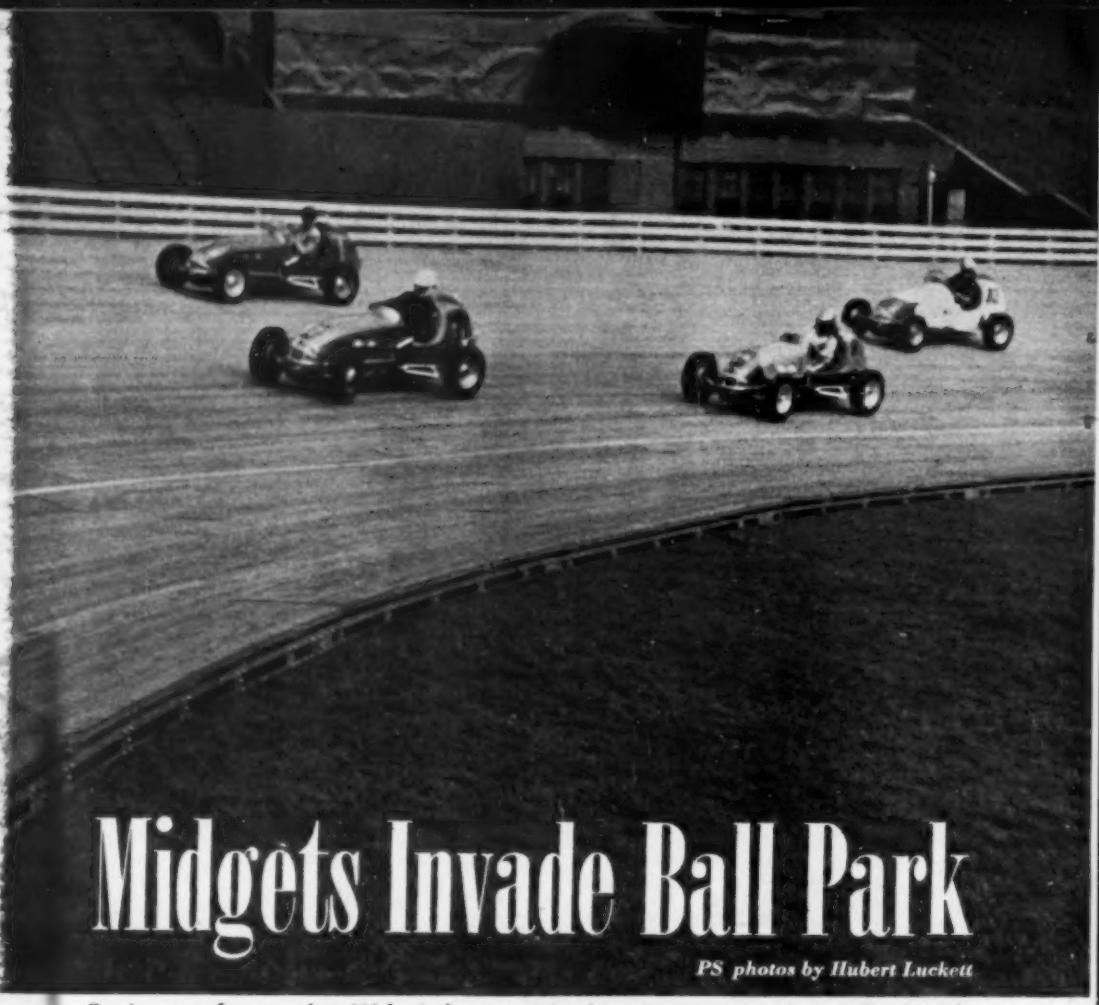
The tee itself is actually a plunger, dropping down below the ground when empty and rising again as soon as a ball is placed on top of it. The ball's weight controls the action of the tee. When the spiral magazine is empty, a warning light flashes on the tee machine and also on a remote-control panel that counts the number of balls used.







Inventor-golfer Joe Mozel steps up to one of the 14 automatic tees on his Portland, Ore., practice range. Diagram at top shows how balls spiral down gravity feeder into tee mechanism. Mechanism (bottom right) is placed below ground with only ball and tee protruding through hole. When ball is hit, unweighted tee drops back through hole, picks up another ball, and then reappears. For iron shots without tee, ball can be rolled onto brush mat to left of tee.



Midgets Invade Ball Park

PS photos by Hubert Luckett

Coming out of a more than 10° banked curve, the midgets speed up for a burst along the straightaway. Scene is N. Y. Polo Grounds where Small Car Enterprises is promoting races.

WHEN the Giants go on the road these days, New York's Polo Grounds does not lapse into its usual sleepy emptiness. Instead, 200 workmen bustle out—and soon the park echoes to the roar of motors. The midgets have moved in.

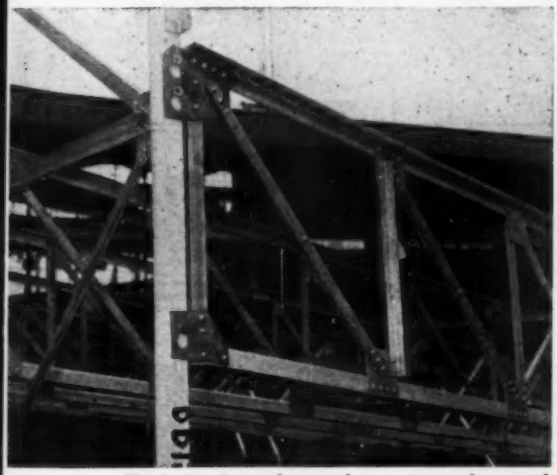
For a new demountable, board track has made it possible to change a ball park into an auto race track in just 18 hours. Twelve hours after the last race the track will have vanished again—with not a blade of grass harmed. As a result, midget-auto racing, reputedly the country's fourth most popular spectator sport, has at last found a home with enough room. When the new $150,000 track made a recent Polo Grounds debut, 40,000 seats were available—five times the capacity of the average midget-auto track.

The one-fifth of a mile wood track is laid over an aluminum frame. It doesn't touch the diamond or even the edge of the outfield. Boards are considered the best for midget auto racing, and the banked curves have already permitted straightaway speeds up to 80 m.p.h. When the drivers have been broken in to it, they expect to hit 100 m.p.h. On the average dirt or macadam flat track 60 m.p.h. is tops.

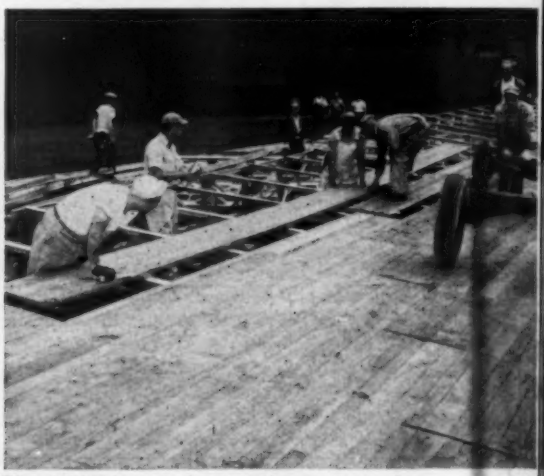
Speed in handling the 235-ton track was the vital problem in opening a big-league park to auto racing. It has been licked—and Lionel Levy, the New York architect who designed the track, believes the time can be cut still further.

Erection is under way above on the first demountable, wood-floored, midget-auto racing track ever installed in a major-league ball park. Upper stands provide best view of the races.

Aluminum horizontal members, above, are dropped into studs on vertical supports at the steepest parts of the banked curves. It takes only two men to carry even the largest trusses.



Keyhole slots, shown above, in stainless steel plates of the horizontal girders are dropped over studs in the vertical supports. Each of the 3,000 girders is coded for quick and easy assembly.



The 2,500 boards forming the racing surface are made of Douglas fir; those used on the curves are steam bent. Hand truck at right is used to transport both boards and metal girders.

Workmen, below, are using chain and tackle to tighten the boards after a section has been assembled. It costs between $5,000 and $7,000 just to put the track up and take it down again.

The track is down and cars are readying for first trials. It is 36 feet wide at the straightaways and 44 feet at the curves. A 12-foot apron on the inside is for disabled cars that pull out.

This is the Plane That Outflies Sound

THE needle-nosed, stubby-winged airplane pictured on these pages has succeeded in smashing one of the world's great physical mysteries. It has flown faster than the speed of sound.

Eight months after the Bell X-1 had sped through the so-called "sonic barrier," the U. S. Air Force conceded that the plane had lengthened the spectrum of future speeds to anything the imagination could contrive. If airplanes can better 660 miles an hour—the speed of sound at the X-1's probable altitude—*they can, with sufficient power, go 1,000 or 2,000 or 4,000 m.p.h.*

That is the significance of the announcement that for the right plane the bogeyman of flying through the sonic speed range had proved to be only a scarecrow. The fact that airplanes could be built that would not shake to pieces at supersonic speeds had been forecast, in fact, by wind-tunnel tests (PS, June, '48, p. 102).

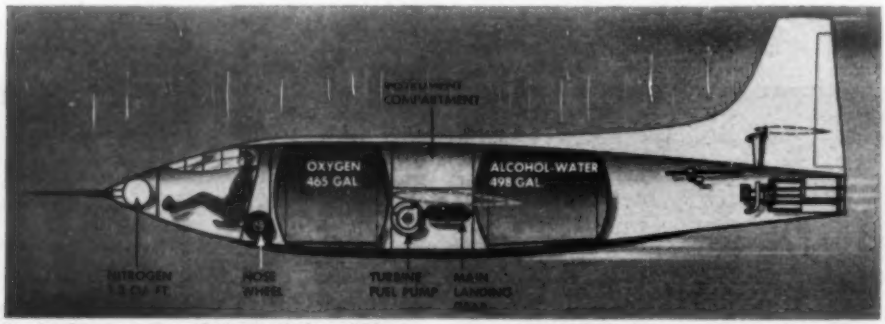
Just how fast the X-1 flew was disclosed neither by 25-year-old Capt. Charles E. Yeager, the first man to zip through the sonic range, nor by the Air Force announcement. But it is a fair guess that the plane got up to or beyond 1,000 m.p.h. The next announced goal of the supersonic tests, held at Muroc Lake, Calif., was 1,700 m.p.h., two and a half times the speed of sound. That is the X-1's estimated top speed at an altitude of more than 15 miles. It has not been explained how many thousands of feet the plane will have to climb to reach that height after its release by the mother ship. The ceiling of the B-29, now used to carry the X-1 aloft, is far below that.

The reason the flights take place at high altitude is that the sonic zone there is reached sooner. In "standard air" at sea level the speed of sound is 763 m.p.h. But the thinner the air, the slower sound travels through it.

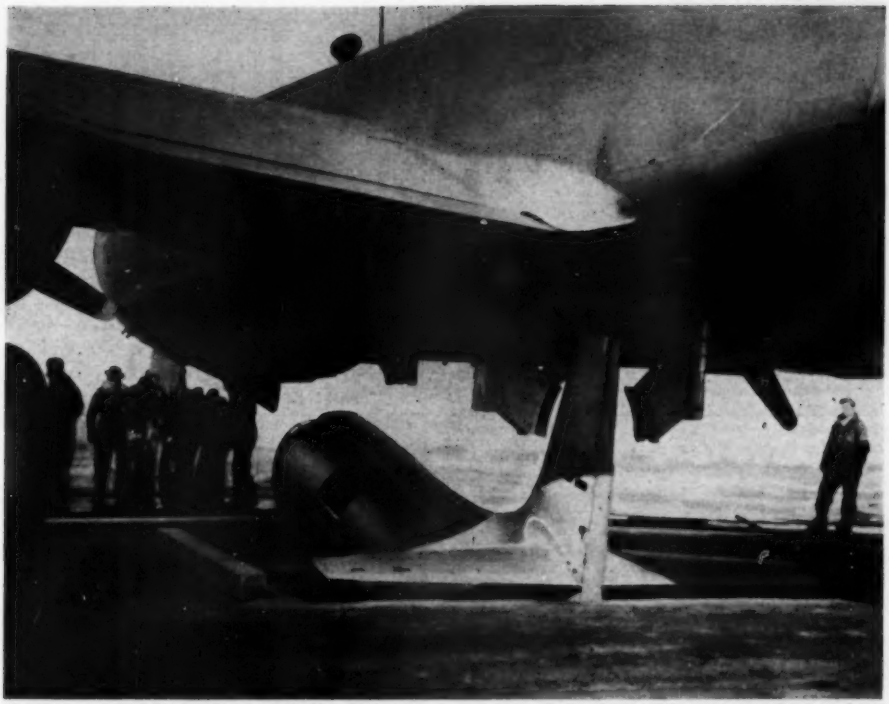
Designed solely to explore the realm of superspeeds, the X-1 probably is the strongest airplane ever constructed (PS, Jan. '47, p. 81). It can withstand 18 times the pull of gravity. At maximum power it develops 6,000 pounds of thrust; with fuel feed augmented by a pump, it will climb 45,000 feet a minute.

Now that a plane with a wing sticking out at right-angles to the fuselage has flown supersonically, the Air Force anticipates even more success with swept-back wings. They delay the phenomenon of high air turbulence that has worried designers these many years. In fact, with sweep-back, the fuselage of a plane can travel at sonic speed while the air flowing around the wing remains in the subsonic area.

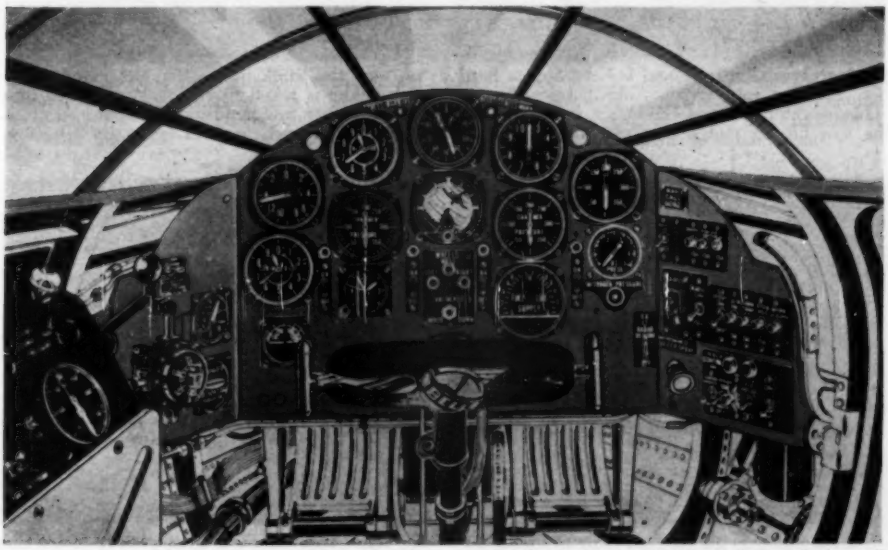
The assaults on supersonic speeds have only begun. It is reported that North American's XF-86, actually designed for military combat, also has flown faster than sound, and two Douglas planes are being groomed to repeat the performance.



Fuel takes up most of the X-1's barrel-like interior, and accounts for two-thirds of its 6½-ton gross weight. Plane burns a mixture of liquid oxygen and alcohol with water. When set on fire, this streams out of four rocket nozzles in the tail. Nitrogen pressurizes fuel tanks.



X-1 is carried aloft under the belly of a B-29 for its supersonic flights. Ferrying the jet to high altitudes is necessary to save its fuel, since it carries only enough for 2.5 to 4.2 minutes of powered flight. Runway trench makes it easier to hook small plane to big one for take-off.



Cockpit of the Bell X-1 is no more complicated than that of a standard fighter plane. Pilots complain, however, that the shape of the nose makes it hard to look out during flight and when landing. Visibility is said to be so bad in climbs that pilots must fly on instruments.

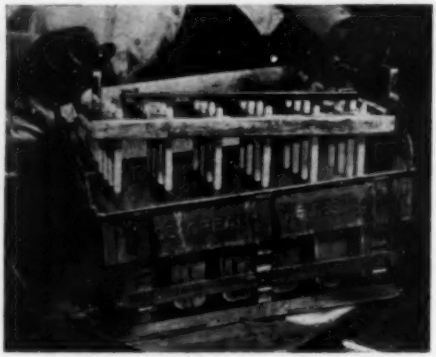
1. Ice-cream-on-a-stick starts out as nothing but a smooth stick. This machine places 24 sticks exactly into 24 holes in holder every time the operator presses a holder against it.

How Ice Cream

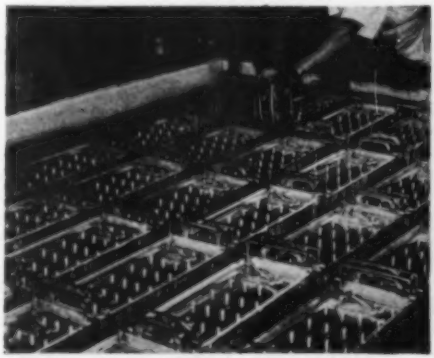
PS photos by W. W. Morris

PEOPLE have been smacking their lips over ice cream for centuries, but nobody thought of coating it with chocolate and putting a wooden handle on it until about 25 years ago. Now hundreds of millions of pieces of ice-cream-on-a-stick are made—and eaten—every year. A single modern plant, such as that of the Mayflower Ice Cream Corp., of New York, where these pictures were taken, turns out 9,000 an hour.

2. Ice cream "mix"—cold but not frozen hard—is squirted into molds from hopper device. This operator is one of the fastest in the county; he can fill 24 molds in about three seconds.



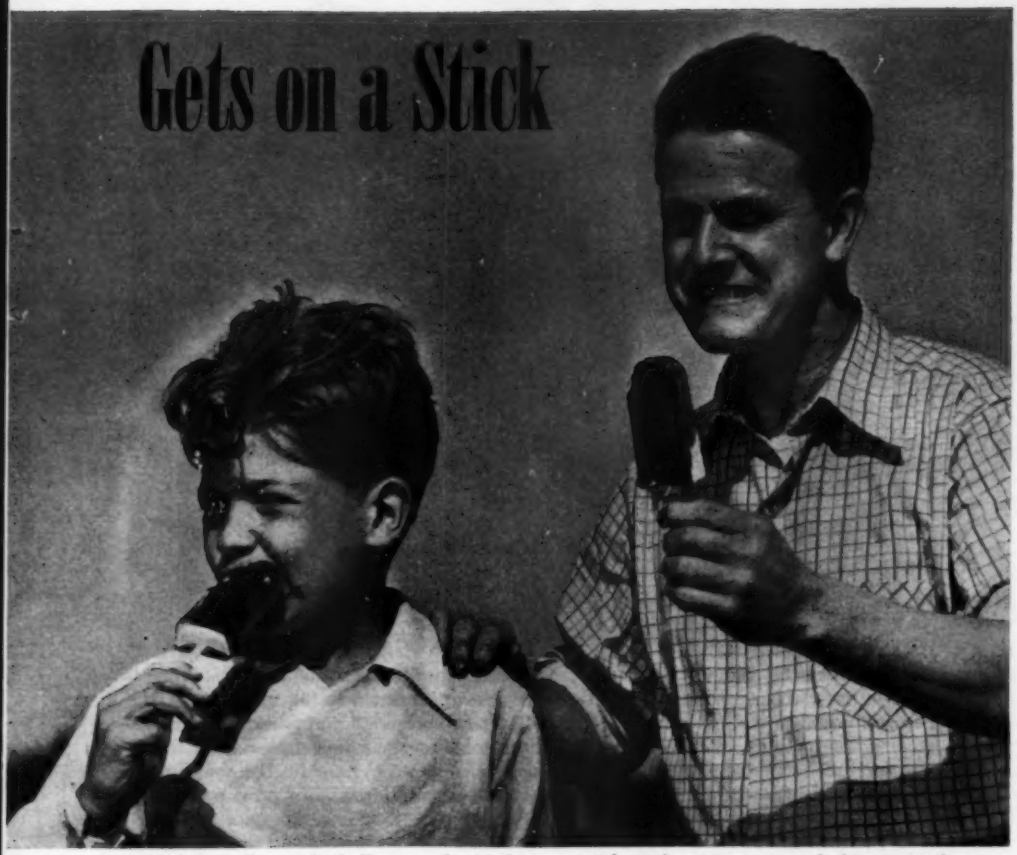
3. Now the stick joins the ice cream. The stick holder is taken from a rack and fitted into the container of molds. The entire unit is then dunked in a tank of brine for freezing.



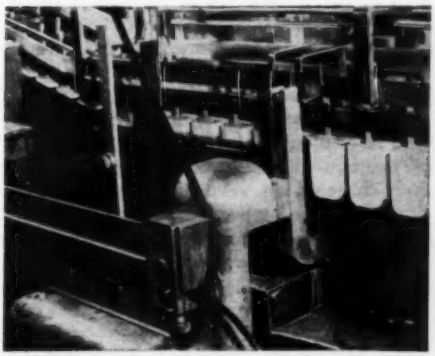
4. Salt water in the tank is kept at about 30° below zero by mechanical refrigeration. It freezes the ice cream in half an hour as molds are pushed through it by bar in background.

5. After trip through brine tank, molds are set in hot water for defrosting. Then the ice cream, frozen firmly to the stick, can be lifted out and sent to the chocolate-coating machine.

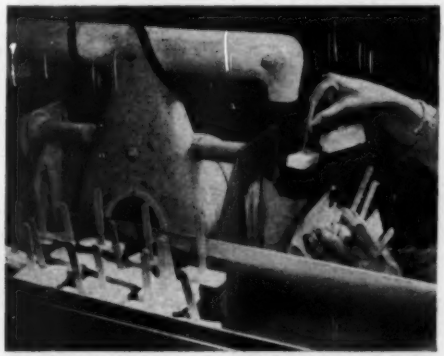
Gets on a Stick



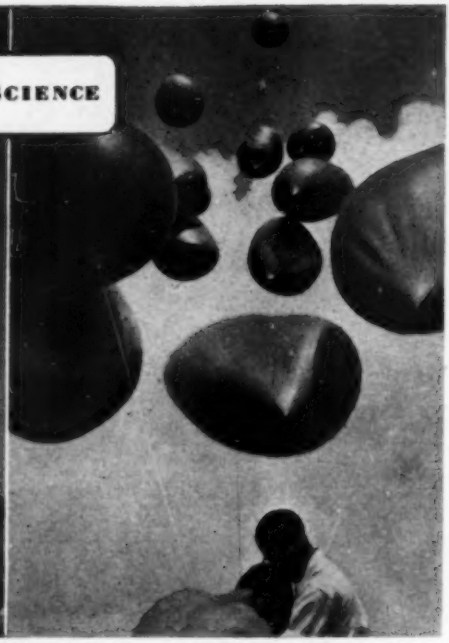
Whether you're at the ball game, the seashore, a mountain resort—or just sitting on the front stoop—you will see this picture duplicated over and over any summer. For ice-cream-on-a-stick is becoming one of the country's most popular hot-weather confections with grownups as well as the kids, rivaling that traditional American institution, the ice-cream cone.



6. Chocolate covering is applied automatically. Machine pulls holder into position over bucket of melted chocolate, then lifts bucket to immerse ice cream so that chocolate freezes on.



7. Fan blows bags open while girl inserts bars. This hand operation will be eliminated by device being developed by Ice Cream Novelties, Inc., firm that made other machines shown.



Trapping Cosmic Rays. The two pictures above show the start of an expedition to capture cosmic rays—those tiny particles, smaller than atoms, that constantly rain down on the earth from outer space (PS, July '48, p. 139).

At left, scientists of the Massachusetts Institute of Technology set their trap, a ray counter and a radio transmitter. At right are the 13 balloons that will carry the 30-pound apparatus, wrapped in cellophane, 19 miles up. Though the outside temperature there gets down to 80° below zero, the cellophane keeps the apparatus warm by admitting the sun's rays faster than it lets them out again. When the balloons break, the instruments come down by parachute.

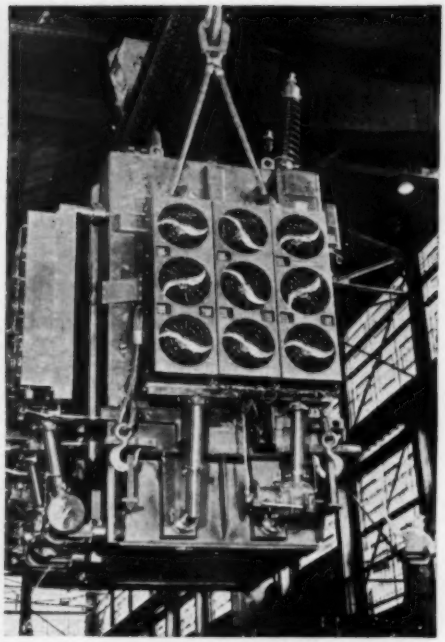
Such expeditions have found fewer electrons than had been expected among cosmic rays before they get mixed up with the earth's atmosphere. This fact may be a clue to the mystery of where they come from.

Split-Second Movie. Resembling a windmill, the odd picture at left is actually a movie lasting a fraction of a second. Photos like these, made with a high-speed camera, are helping Navy scientists to study hydrodynamic principles affecting the performance of torpedoes.

A sheet of film revolves on a disk in the camera, and a vane-shaped sector is exposed for one half-millionth of a second to make each "frame." A complete revolution of the disk, which takes 1/30 of a second, yields 16 views made in rapid succession.

The example at left shows a steel ball, released from a solenoid, or magnetic coil, dropping into a tank of water covered by an oil film. In the final frame, at bottom, it is sinking at the rate of 17 feet a second.

Cannon Fires Thunderbolts. Using this "gun," Westinghouse engineers are testing insulating gases that may replace oil in future transformers of smaller design. At the breakdown limit of gas placed in the barrel, a fiery arc leaps between electrodes. The electric potential producing the arc can be raised to as much as 600,000 volts.

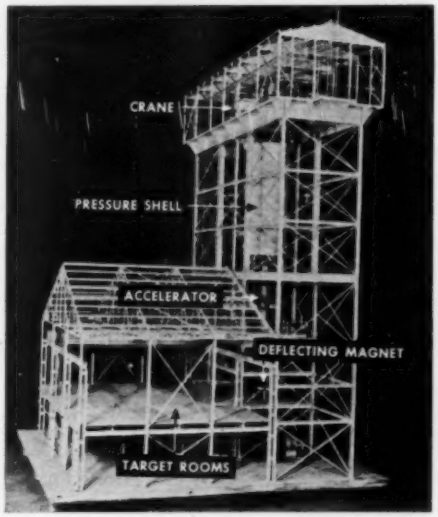


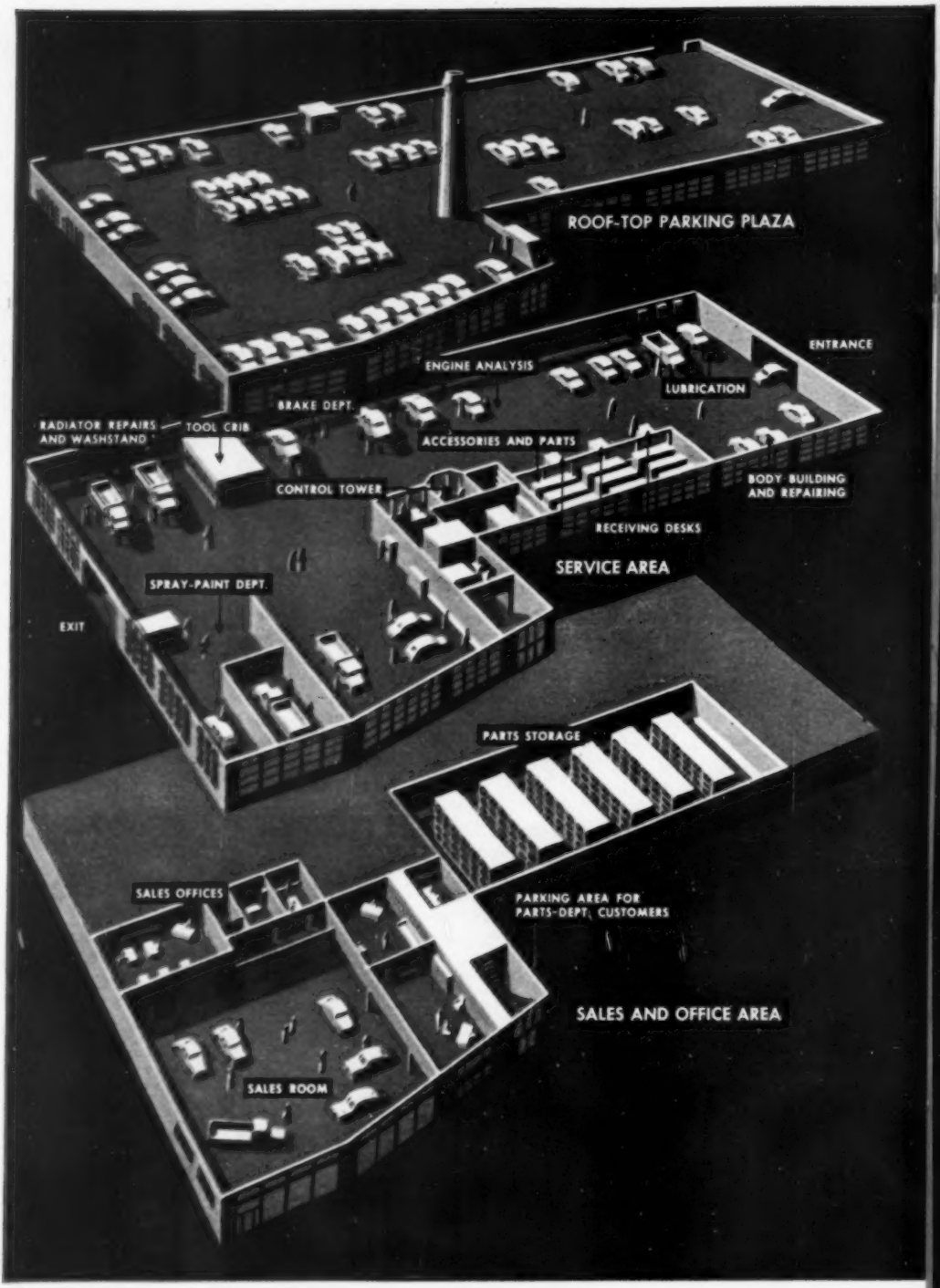
Giant Transformer. Mightiest built in the U. S., the Westinghouse 142-tonner above handles 110,000,000 watts—enough for a city of 200,000. It will step up a Buffalo, N. Y., steam power plant's juice from 13,200 to 115,000 volts to feed the area's electric transmission lines. The propeller-shaped fans cool its oil-filled radiators.

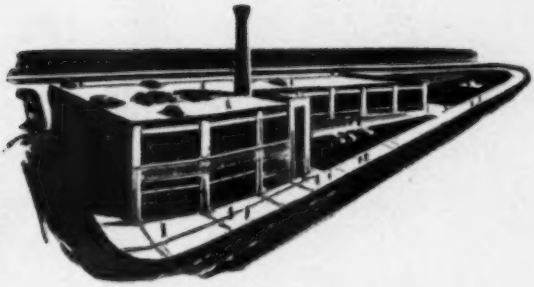
New Gun to Shoot Atoms. The L-shaped skeleton at right is an engineer's model for the biggest Van de Graaf electrostatic accelerator in the world. The Atomic Energy Commission will build it at Los Alamos, N. M., to smash atoms for research by University of California scientists.

The building, 120 feet high, will be set against a mesa cliff to brace the tower and provide a radiation shield for the control room on top of the mesa. To increase its capacity, the accelerator itself will be enclosed in a steel pressure vessel. This shell, 13½ feet in diameter and 39 feet high, can be lifted by a 150-ton crane, as shown in this view of the model, to expose interior parts for servicing.

Streams of protons or deuterons, at up to 12,000,000 electron volts, will be shot downward and deflected by a magnet into the target room.




ROOF-TOP PARKING PLAZA
ENTRANCE
ENGINE ANALYSIS
LUBRICATION
BRAKE DEPT.
RADIATOR REPAIRS AND WASHSTAND
TOOL CRIB
ACCESSORIES AND PARTS
CONTROL TOWER
BODY BUILDING AND REPAIRING
RECEIVING DESKS
SERVICE AREA
SPRAY-PAINT DEPT.
EXIT
PARTS STORAGE
SALES OFFICES
PARKING AREA FOR PARTS-DEPT. CUSTOMERS
SALES AND OFFICE AREA
SALES ROOM



New Garage Has Built-in Efficiency

By R. Lloyd Guyette

PS photos by W. W. Morris

DRIVING up to the service entrance of a garage that opened recently in Hartford, Conn., a new customer is surprised to see its massive door lift up before he has so much as sounded his horn.

That's only his introduction to a wonderland of mechanical efficiency that is no more like your corner service station than the Mayo Clinic is like a country doctor's office.

This superservice station, part of the Sloate Chevrolet Co.'s new Auto Center, occupies one of three main floors in a building fitted against the side of a hill so that all have entrances at street level. Above the service floor is a roof-top parking plaza; below are offices and sales room.

In the series of photographs beginning below POPULAR SCIENCE takes you on a picture tour of this modern automobile clinic.

Electric eyes over entrance to superservice station open door when car breaks beams of light from two of several slits in driveway. Pedestrian, breaking only one beam, won't open it.

First stop inside new Hartford auto clinic is service salesman's desk, one of three. Customer announces what he wants done to the car, and salesman writes out the work order in triplicate.

Pneumatic tubes carry copies of work order from salesman to dispatcher in control tower. To right of tubes is sound-insulated booth with both intercom microphone and outside phone.

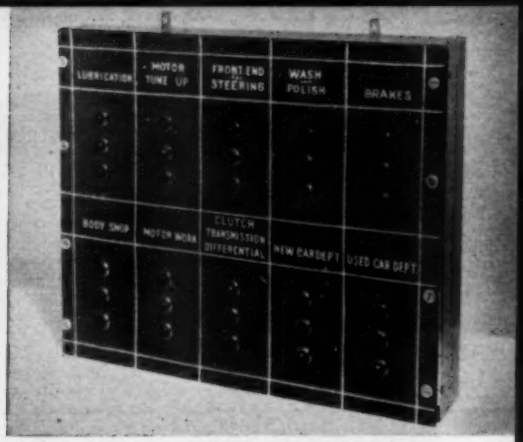
Lubrication department is kept spotless by drainage of waste oil into underground tank. Hydraulic lifts can raise either or both ends of a car. They will handle the heaviest trucks.

New oil is drawn by gravity from tanks hung from the ceiling, eliminating pumps. Tanks can be refilled from the roof-top parking plaza, without a tank truck having to enter the building.

Spray-painting booth (below) is big enough for school bus. It's ventilated by fans that push out 27,000 cu. ft. of air a minute. Porous-glass doors, when closed, filter dust from incoming air.

Clerk makes card record of each servicing job and posts it on board below. From that, Auto Center mails reminders to customer after 30, 60, and 90 days to bring car in for checkup.

Dispatcher in glass-enclosed room on mezzanine of service department directs flow of all work. From chart showing progress of each job, he can tell customer when car will be ready.



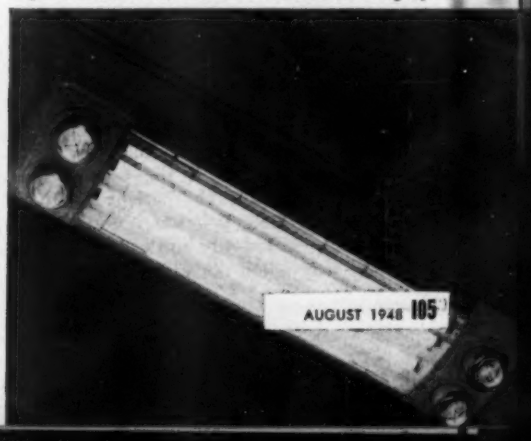
Signal panel controlled by dispatcher shows salesmen what sort of jobs to accept for immediate attention: green light for yes, red for no, yellow as a warning to check with dispatcher.

Exhaust fumes from car during motor tuneup, or when merely idling, are carried off by flexible suction hose to duct under floor. Fans change air throughout building four times every hour.

Accessories are displayed near service salesmen's desks to catch customer's eye when he leaves car. New parts needed for any repair job are ordered from here by the dispatcher.

Customers waiting for cars to be serviced may relax in attractive showroom, below, decorated with mural depicting history of transportation. Loudspeaker tells them when cars are ready.

Showroom lighting fixtures (below) hold both fluorescent lamps, for general illumination, and small spotlights that can be focused individually on the mural and new cars on display.

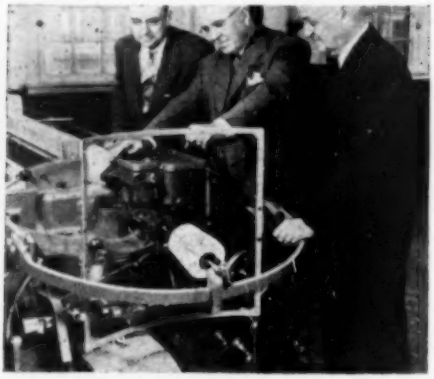


Crane Lifts Big Load

THIS one-man, mobile Tournacrane Ⓣ carries a 7-ton load and turns on a 20-foot dime. The boom rides up and down on an elevator track, providing a 31-foot reach when fully extended. The track tilts backward to a horizontal position, and can be tipped forward to bring the load over wheels for better weight distribution. Three electric motors operate pulley, boom, and elevator track, while a fourth steers the crane.

Invalids Get a Lift

INVALID patients get a lift—literally—with this Porta-Lift Ⓣ for home or hospital use. One person operating the hydraulic jack at the side can lift a patient into or out of beds, wheelchairs, or automobiles. A seat hanging from an arm at the top of the wheeled stand supports the patient in either a sitting or reclining position. "Outrigger" wheels give good stability and can be folded out of the way when not in use.

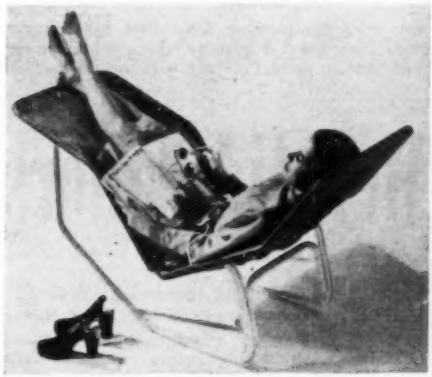


Machine Weaves Faster

AN ENDLESS stream of high-speed, steel shuttles replaces the usual single, wooden shuttle in this new Swiss-designed weaving machine. Made by Warner and Swasey, the "rapid-fire" loom has nearly three times the cloth output of ordinary machines. Lacking a bobbin, each shuttle grips the thread to make only one trip across the loom. It then releases the thread and drops onto a conveyer that carries it back for later use.

Handy Box Aids Driver

THIS versatile box, shaped to fit a car seat, can do four jobs for a motorist. Closed, it serves as a picnic-lunch box and at the same time as an arm rest for the driver or an elevated seat for Junior. Opened, as above, the hinged cover reveals a vanity mirror that swivels to any angle. The Auto Bed Shop, Los Angeles, sells it for $13.50.



Chair Doubles as Lounge

THIS CROSS between a deck-chair and a rocker lets you lean back and put your feet on the desk—without a desk. Thanks to the angle in the bottom rails, it can either be used semi-upright or tilted 'way back, as above. Called the Barwa ⓣ, the chair is said to be scientifically shaped to the natural contour of spine and legs in relaxation.

Camp Stove Fits Pocket

THE new camp stove shown above takes little more room in a sportsman's pocket than a fishing reel or a box of shotgun shells. When folded (inset) the Taykit ⓣ measures only 5 by 4½ by 1⅞ in. Set up, with the carrying-case walls pushed out as windshields under two sides of a wire grill, it's big enough for a frying pan, a coffee pot, or a four-quart kettle. The stove burns gasoline, but needs no pressure pump. Cupping your hands around the burner warms air in the fuel line to squeeze out a drop for a generating flame, and the stove's own heat keeps up the pressure. It will burn an hour and a half on one four-ounce filling.

Baby Cart Has Rockers

THE Babycar ⓣ, above, was recently shown for the first time at an industrial fair in Holland. The wheels let down to lift it off the rockers, and a handle can be fastened on at the front to pull it by.

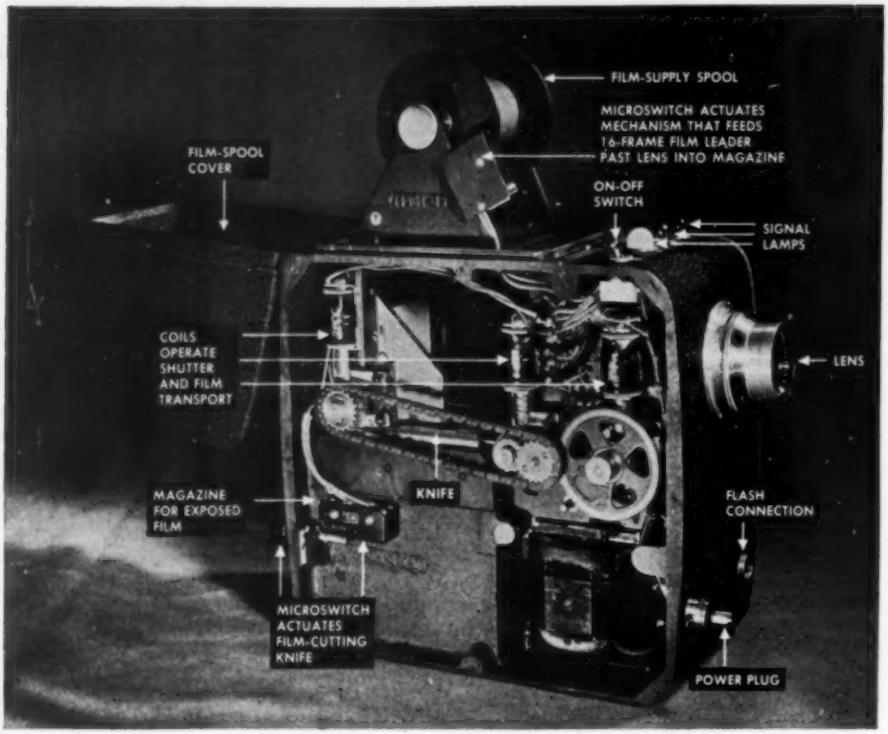


Photo-Metric camera, shown open, is easy to run, almost foolproof. As soon as one 70-mm. film frame is used, another moves automatically into place, preventing double exposures. Push-button snap switch operates knife that cuts frames apart so salesman can remove exposed film at any time. Two synchronized flash lamps have life of 10,000 flashes, need infrequent replacement. Shutter speed is fixed at 1/10 second, lens aperture at f/8. Red light warns when film spool is empty; white, when power is on; amber, when picture is being taken.

Contour Maps of Men Aid Tailors

By Paul F. Ellis

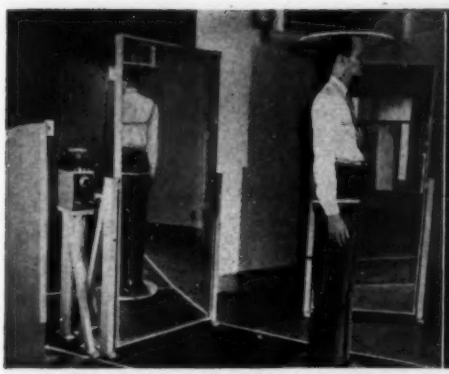
PS Photos by W. W. Morris

MAKING a suit of clothes really fit a modern man's bulges, slopes, and protrusions is difficult craftwork. But engineering, physics, and optics have been combined now in a Photo-Metric® process to help both tailors and their customers.

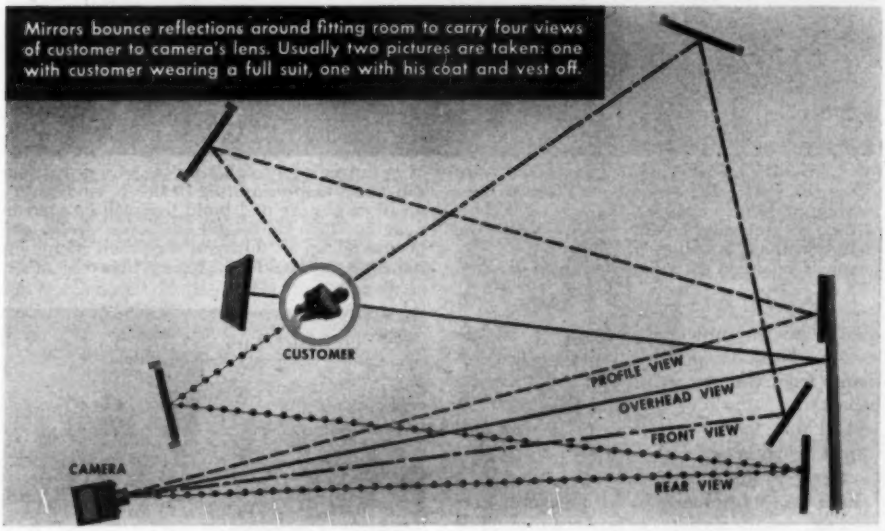
It requires a unique camera, a set of mirrors, and a tricky calculator. Henry Booth, president of Amalgamated Textiles, Ltd., invented the system, and it has been introduced by a subsidiary of his company, which is licensing its use by retailers and manufacturers.

When you order a suit made this way, you will be asked to stand on a low pedestal and be photographed. You will wear a harness made of tape measures bearing large numbers showing your measurements. Your name and address will be photographed along with you. Then the suit will be made. You will not have to return for fittings or adjustments.

The camera, designed under direction of Eastman's Dr. Kenneth Mees, is the heart of the entire technique. The salesman



Customer being fitted for suit wears harness of tape measures and stands on platform surrounded by mirrors. These reflect his image—as seen from front, rear, side, and overhead—to camera in corner of room. When salesman presses button, all four views (shown at right above) are photographed simultaneously on a single frame of film in a fraction of a second.



Mirrors bounce reflections around fitting room to carry four views of customer to camera's lens. Usually two pictures are taken: one with customer wearing a full suit, one with his coat and vest off.

using it is said to need only a half hour's instruction, principally on how to load the film. The focus, the shutter speed, the light values are all permanently set. To load the camera, the salesman raises the cover. No threading into sprockets is required; the operator merely places the spool of film on the spool holder and inserts the film leader into a slot until it comes to a stop.

As the cover of the camera is tightened down, it trips a switch that automatically puts the winding mechanism into operation so that the first 16 frames are run through without any pictures being taken. This is insurance against the use of exposed film at the beginning of the roll. To extract the film, the salesman presses a button that activates an electrically controlled lock, automatically sealing off the magazine from outside light or dust. It isn't necessary to wait until all the film on a roll has been used up; it can be chopped off any place by pushing a button.

The picture taken by this camera is a multiple reflection of the customer's images as they appear in four optical mirrors. The negative is developed and placed on a slide. This goes to a workroom where "blue pencil

Clerk reads measurements from four-way image thrown on large translucent screen from back by projector focused on mirror at left. This method of projection lets him work close to the picture without standing in path of the light. Image is enlarged to a predetermined fraction of customer's actual dimensions. Clerk is using calibrated map-measuring device to study every detail of posture and build that will be used in tailoring suit. Horizontal bar across screen can be moved up or down to see whether, for instance, one shoulder is higher than the other.

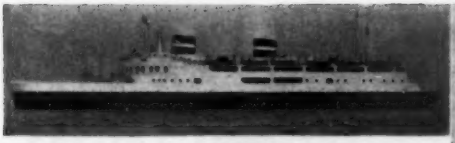
men" view the projected negative on a large screen. These experts read off the measurements from the projection and put them on a pad.

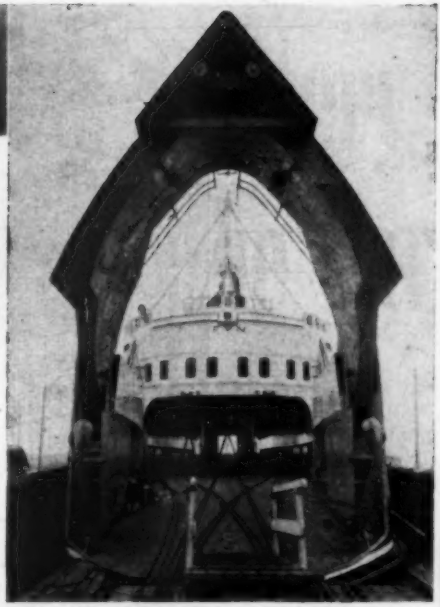
The data obtained this way is then fed into a "calculator." In it, the Photo-Metric Corporation previously has placed what it estimates to be the normal measurements for any certain size, such as a 39 regular, a 42 long, or a 36 short. The calculator, according to the company, presents estimates for about 500 different patterns of men's clothing. The customers variations from one of these are determined with the help of the calculator and a slide rule. The cloth can then be cut and the suit completed. END

Slide-rule calculator works out the final figures to guide tailor in cutting material for suit. It determines these by comparing customer's actual measurements with dimensions of various standard sizes for different models. Scale is set in advance for particular type and style of suit wanted.

Neat Trick if You Can Say It

PAUSING several times to take a deep breath, a speaker recently told the American Chemical Society that piperonyl cyclonene is a mixture of chemical substances, the most important of which is "hexyl-5-(3, 4 methylenedioxyphenyl)-3-carbethoxy-2-cyclohexen-5-one."



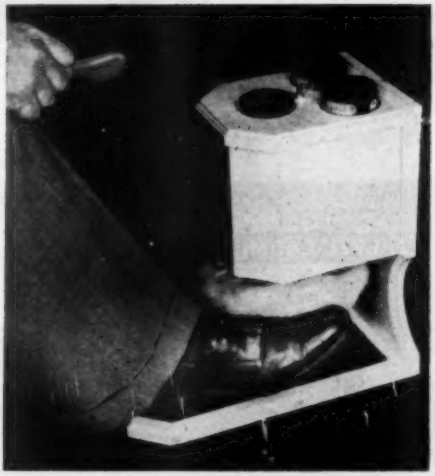


Trains Get Ferry Ride

When the giant "jaw" at the right snaps shut, it swallows 30 railway cars. It's the upper bow section on the Danish ferryboat *Fyn* (above), which carries railroad cars on the 15-mile run between Nyborg and Korsor. Rising like a drawbridge, the bow permits railroad cars to roll directly from tracks on the dock to tracks on the ferry's deck. The modern ferry can also carry 1,500 passengers. It cruises at better than 16 knots.

Water Shuts Hose Valve

The water itself does the work in this self-closing Paul valve for water hoses. The opening into the nozzle is smaller than the valve chamber, so the water must speed up to get through, causing a drop in pressure at the opening. This forces a ball inward against the opening, shutting off the water until the plunger on top is pressed down, pushing the ball away from the opening.

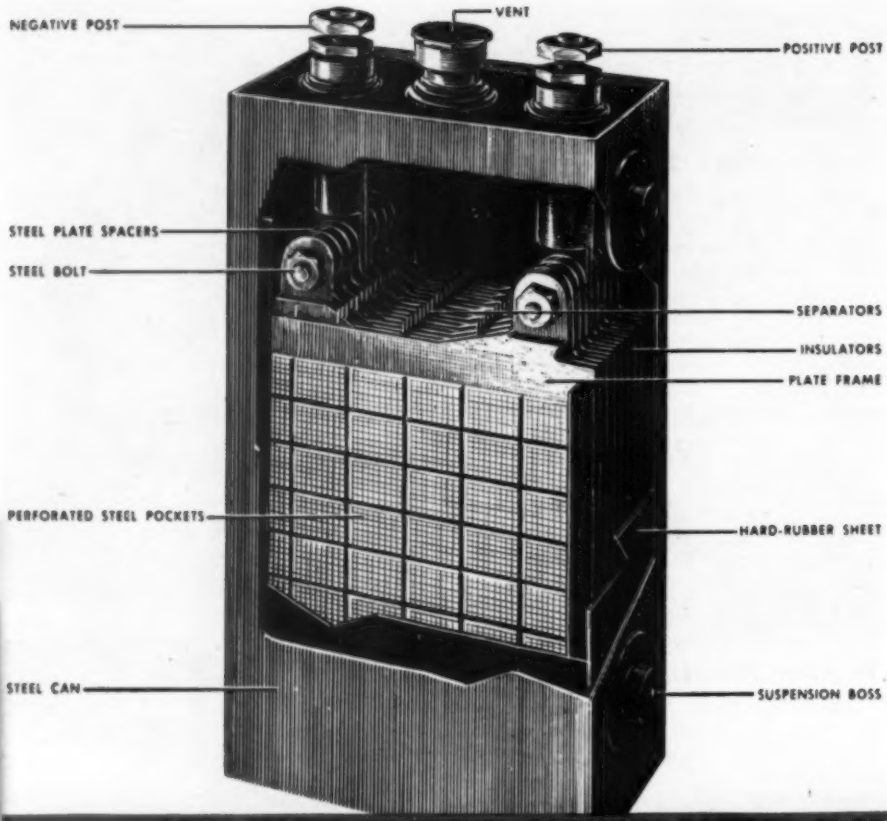


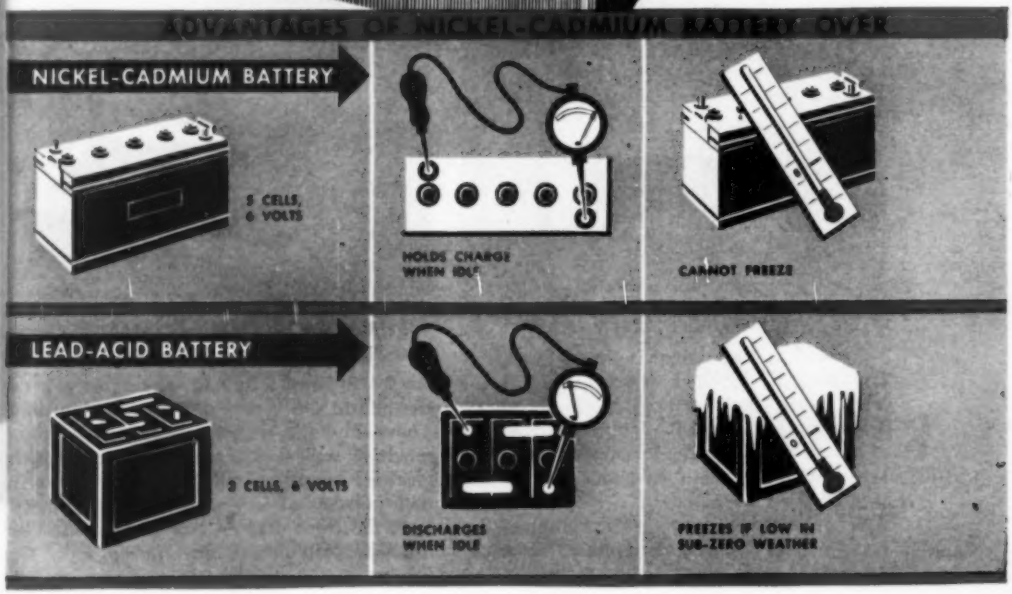
Tiny Pencil Clips Tie

Less than four inches long and only an eighth of an inch thick, this tiny mechanical lead pencil can be worn as a tie clasp. Made by the Slencil Co., of Orange, Mass., it has a long, spring-wire clip on the back that fastens the tie to the shirt. The lead is propelled or retracted by a single knurled roller recessed in a slot in the center of the pencil. The top, taken out and reversed, provides a convenient eraser.

Electric Shoe Shiner

Want an easy shoe shine? The Groomaster® will meet you half way. Just put on the polish, slip your foot under the whirling buffer, and this portable home shoe-shining machine will do the rest. The eight-inch electric sheepskin buffer works the wax in and polishes at the same time. If placed near the front door, it can also be used as a handy shoe cleaner for entering feet. On top are places for three jars of wax.


NEGATIVE POST
VENT
POSITIVE POST
STEEL PLATE SPACERS
STEEL BOLT
SEPARATORS
INSULATORS
PLATE FRAME
PERFORATED STEEL POCKETS
HARD-RUBBER SHEET
STEEL CAN
SUSPENSION BOSS


ADVANTAGES OF NICKEL-CADMIUM BATTERY OVER
NICKEL-CADMIUM BATTERY
5 CELLS, 6 VOLTS
HOLDS CHARGE WHEN IDLE
CANNOT FREEZE
LEAD-ACID BATTERY
3 CELLS, 6 VOLTS
DISCHARGES WHEN IDLE
FREEZES IF LOW IN SUB-ZERO WEATHER

Nickel-Cadmium Battery Lasts as Long as the Car

New to United States, this European juice box will not crack, freeze, spill acid, or run down when left idle.

By Harland Manchester

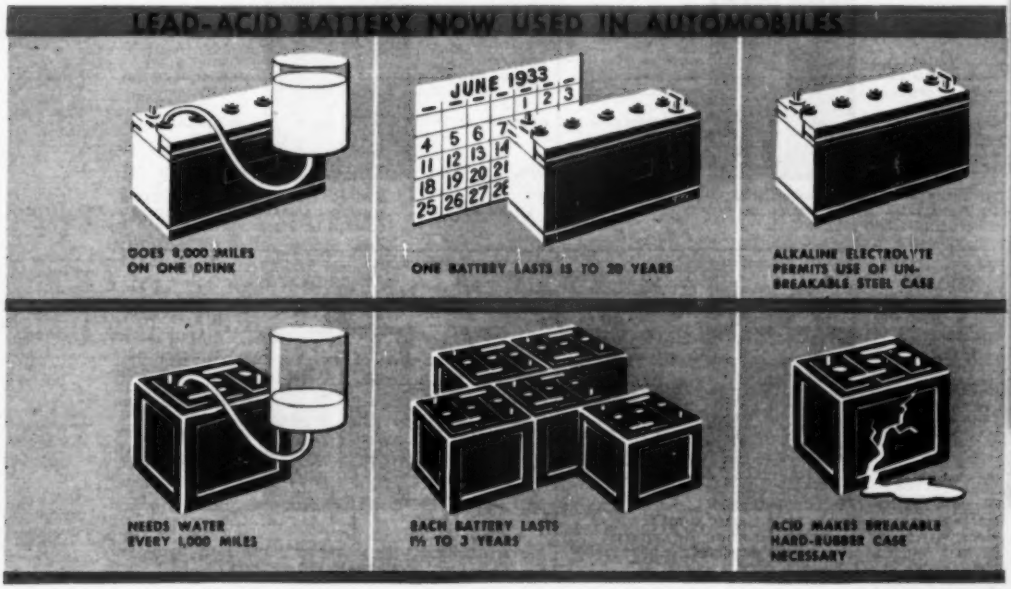
PS photos by W. W. Morris

ONE of the greatest headaches of the American driver is his automobile battery. If left untended in storage, it grows green whiskers and dies; if it gets low in sub-zero weather, it is liable to freeze and crack. Jolting on rough roads may break its hard-rubber case, and without frequent drinks of water it ceases to function. Even with careful nursing and no mishaps, it often has to be replaced several times during the life of a car.

Yet there is a battery, new to the United States, that has none of these failings. It will no crack or freeze. Put it away all winter, and it holds its charge and does not deteriorate. Equipped with this juice maker, you wouldn't buy a new battery for your car—you would buy a new car for your battery, for it will last 15 or 20 years.

Ask your service man about the nickel-cadmium battery and he'll tell you he never heard of it. Look in American textbooks and you won't find it. Yet this superior battery has been used all over Europe for nearly 40 years.

Possibly six Americans are using this

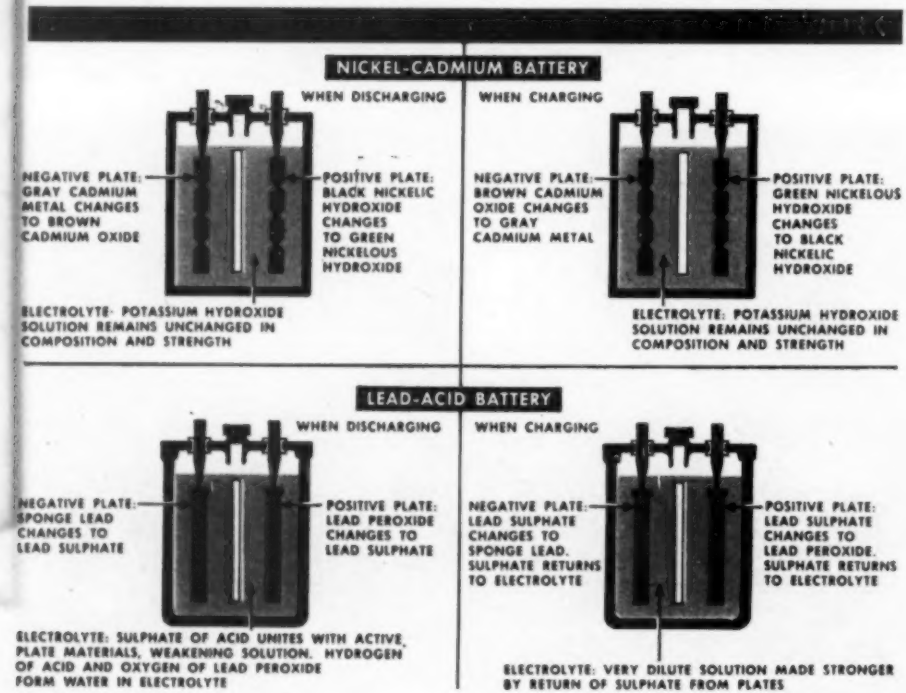


First step in making nickel-cadmium battery is perforation of long strips of steel tape by these needles in the head of a mechanical hammer.

Tape then is flanged to form trough with tiny holes in bottom. Pictures were taken in first U. S. production plant at Easthampton, Mass.

battery today in automobiles and boats. A New York businessman put one in his Chrysler 18 months ago and has run it 40,000 miles without adding water, leaving his car outside on sub-zero nights. It is still full of life. A Rochester man put these batteries in his Diesel-powered fishing boat and laid it up for nine months without attention. Last January he stepped on the starter, and the engines roared.

Novel as this may be to Americans, it is old stuff in Europe. The nickel-cadmium battery was first produced in Sweden in 1909, and since then its manufacture has extended to England, France, Germany, Russia, and a dozen other European countries. It is used in thousands of buses, railway cars, Diesel locomotives, switch yards, signal systems, air-conditioning plants, utility systems, yachts and liners, and in small portable electric lamps. It was one of the refinements installed in the *Queen Eliza-*



Active material of battery is pressed into trough. Positive plates get nickel hydroxide and graphite; negative plates, cadmium oxide and iron.

Trough packed with powdered oxides now has second perforated tape clamped over it to hold chemicals but admit battery fluid through holes.

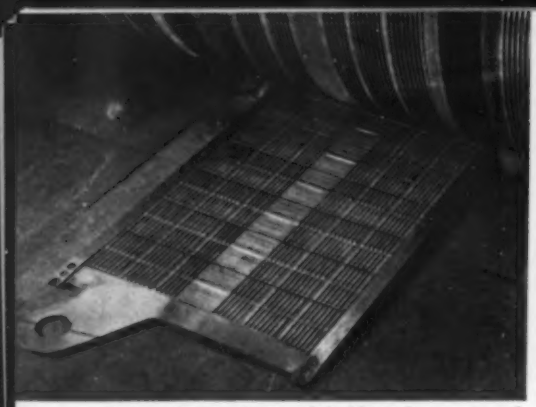
beth, the *Queen Mary*, and the *Normandie* as an emergency power source to run lights and various devices. During World War II the Germans used this battery in the V-2 rocket, and it supplied reliable starting and easy maintenance for planes, tanks, trucks, submarines, and other fighting equipment in all occidental armed forces—save those of the United States. Americans not only haven't been able to buy the battery, they have remained in almost complete ignorance of its existence.

At long last, the wall of silence has been broken down, and the better battery is actually being manufactured in a plant in Easthampton, Mass. During the war, American experts on the hunt for more efficient equipment had a chance to see the battery and test its superiorities over the lead-acid battery commonly used in the United States. One of these experts, Lt. Col. H. B. Nichols, a West Pointer of the Air Materiel Command, determined to introduce it in this country. As soon as he took off his uniform, he secured the services of Carl Berg, son of the battery's co-inventor and one of the world's leading engineers in the field. He then formed a company and set up a small factory. During the last year, his firm, the Nickel Cadmium Battery Corporation, has turned out batteries in sizes ranging from a tiny model suitable for a hearing aid to giant multiple units that will start a Diesel locomotive. He has not yet entered the automobile field, but has sold about 2,000 of the new batteries to railroads, utility firms, oil companies, bus fleets, and other industrial users, and his files bulge with orders and inquiries from all over the country.

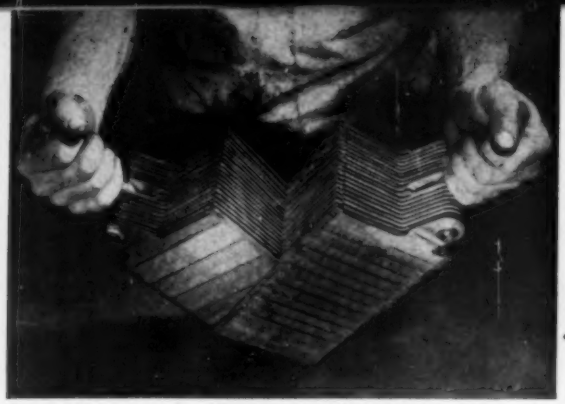
The virtues of this battery stem from chemical and mechanical properties radically different from those of the hard-rubber-cased ones familiar to Americans. The latter yield electric energy by the chemical action of a sulphuric acid solution on a series of lead and lead-oxide plates; while the new battery delivers juice through a chemical change in plates of cadmium and nickel hydroxide, using a solution of strong alkali as virtually nothing more than a conductor of electricity. The chemical difference accounts for its long life and the fact that it can be stored without deteriorating. And because an alkaline liquid is used, it can be housed in an unbreakable steel container, which acid would eat through.

How It Was Born

The story of this battery goes back to two ingenious young Swedes, Waldemar Jungner and Karl Ludvig Berg, who finished technical school about 1889 and looked about for something to invent. Berg, a mechanical genius who worked for Jungner's wealthy uncle, a cereal manufacturer, had already built machinery for processing rolled oats. It was a dry summer of many fires, and Jungner designed a battery-operated fire-detection device called a "pyrophone," which rang a warning bell when fire heated thermocouples in the form of wires strung around the ceiling. The device got publicity, and orders poured in that swamped the manufacturing force, composed of Jungner, Berg, and Jungner's two sisters. Then angry complaints came in that the pyrophone wasn't working. They investigated and found that the dry-cell batteries were dead. They quickly decided that to save the business they had to invent a new battery that would hold a charge during a



Stripped together and held in frame, trough units form plate. This is now corrugated crosswise by roller press (above) to add strength.



Assembled sheaves of positive and negative plates are intermeshed. Two prongs held by workman are opposing terminals of the battery.

long idle period and, while they were about it, that they would work out a new storage battery instead of trying to improve the dry cell. So with Jungner as the chemical expert and Berg the physicist, they tested all manner of metals and chemicals that could possibly be used in the electrochemical storage of power. They saw no hope of getting the long life they desired from an acid battery, and tested metals that would work with an alkaline solution. They settled temporarily on nickel and iron, and in 1899 Jungner took out a Swedish patent covering all alkaline batteries.

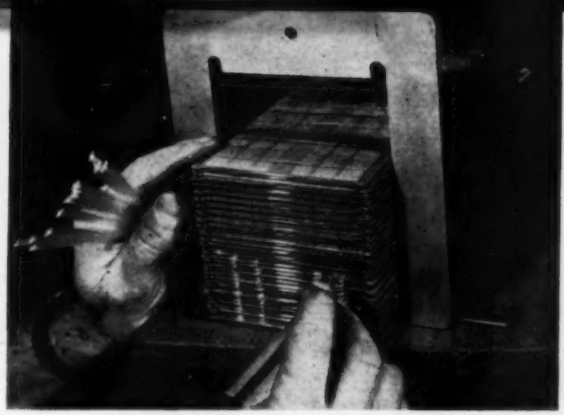
One Step Beyond Edison

At the same time, Thomas Edison was working on the same problem, and at the turn of the century began to make a similar battery. Both batteries gave trouble, and both manufacturers halted production to do more research. Edison corrected the trouble, and continued to make the nickel-iron battery, which is well suited to a number of uses. But the Swedish firm shifted from iron to cadmium, a soft, gray metal obtained mainly as a by-product of the processing of zinc, and in 1909 began to turn out this completely new battery, superior in many ways to all other batteries on the market.

By the end of the next decade, four firms, in Sweden, England, France, and Germany, were making nickel-cadmium batteries under various licensing agreements, and assembly plants in other European countries were making everything but the active chemical material, which the "master companies" made by secret formula and shipped in drums.

As time went on, bus fleets and railroads reported that the batteries they had bought 10 and 15 years before were as good as new. A cadmium battery installed in a Diesel rail car in Sweden in 1913 was still in use at the latest report, after starting the engine 300,000 times. The battery became popular in motorcycles because it stood up under heavy vibrations. Many business and professional men and automobile fanciers installed it in their cars, although the price was about twice that of a comparable lead battery.

The new rival caused anxiety among the makers of lead batteries, which have a normal life of one and a half to three years. Until last year, when a suit for violation of the Sherman Antitrust Act broke up the cartel, the world's three major manufacturers of lead batteries cooperated closely. These are: the Electric Storage Battery Company, of Philadelphia (100 percent owner of the Willard Storage Battery Company, of Cleveland, and Exide Batteries of Canada, Ltd.); Chloride Electric Storage Company, Ltd., of London; and Accumulatoren-Fabrik Aktiengesellschaft (AFA), of Berlin. Following conventional cartel practice, these firms had for several decades exchanged patents and secrets, allocated sales territories, and fixed prices of their products throughout the world. Early in the '20s, members of this group began to acquire holdings in the cadmium battery firms, and by 1936 the cartel had established sufficient control and influence over its rival to direct policy. Prices of cadmium batteries were then artificially pegged at about three times those of lead, but that did not deter buyers. Users in Mexico, Brazil, Argentina, Chile, Uruguay, India, Malay, Siam, and South Africa enjoyed its advantages, and it penetrated even to remote regions in Afghanistan and Tibet,



Separators of polystyrene, a nonconducting plastic, are inserted between the plates so that alkaline battery fluid can get between them.

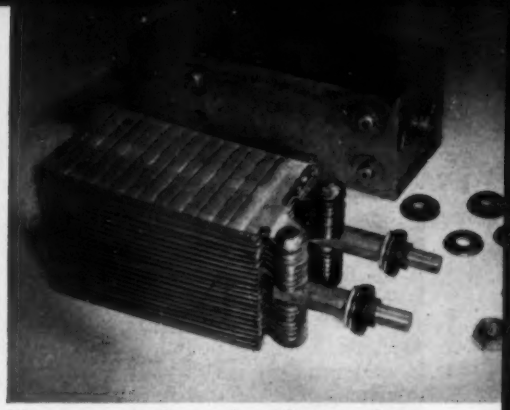


Plate group is shown alongside its steel case. Together, they form finished nickel-cadmium battery cell with a 360 ampere-hour capacity.

while it was not available in Canada and the United States.

By this time the original Jungner patents had expired, and there was nothing to keep an independent American manufacturer from making the battery—except lack of technical information, as well as complete ignorance of its existence. Curious visitors have been barred from the plants. The *Encyclopedia Britannica* devotes eight pages to the lead-acid and the Edison batteries, but does not mention the widely used cadmium battery. Twenty leading physics books used today in American high schools and colleges all describe the lead battery, but not one of them mentions the nickel-cadmium type. Out of 18 "up-to-date" textbooks on electrical engineering used in our technical schools, only one contains a single line about this battery. This means that few technical men trained in the United States have ever heard except by accident of this superior battery with which European and Russian engineers have long been familiar.

Inventor's Son Comes to U. S.

When the cadmium battery companies became a virtual appendage of an international cartel that thrived on its vast replacement market, many zealous engineers chafed under the new restrictions. One of them was Carl Berg, then chief engineer of Alklum Storage Batteries, Ltd., of England. In 1938 he left his job and came to the United States, bringing with him his brother Marcus, the firm's production manager. The Bergs' contracts, like others in the cadmium-battery field, stipulated that if they should leave Alklum they should not engage in manufacture of the battery for five years. Berg found this clause to be unenforceable legally, and sought backers in this country.

Under Berg's direction, faithful copies of the ingenious machines designed by his father over a period of 20 years were set up in the Easthampton plant. Lengths of narrow, perforated steel tape are clamped together, forming pockets to hold the active chemicals, and the thin pockets are combined to make battery plates, which are installed in durable cases of nickeled steel. Shopping for the special steel tape, Berg was able to buy a consignment of 108 tons, tailored precisely for nickel-cadmium batteries, that had been manufactured here for shipment to Russia under Lend Lease and left behind on a Brooklyn dock. Using parts made in America, Russia is reported to have four factories turning out the batteries we haven't been able to get.

Oil companies were among the first customers. Used in starting engines that drive the oil-field pumps, many lead batteries last a few months—cadmium batteries have been used a year and a half and show no signs of deterioration. They are used in the urban buses of the Springfield Street Railway Co., and in the intercity Diesel buses of Trailways of New England. William Corrivau, Trailways maintenance engineer, reports that his lead batteries need water every 1,000 miles, while his cadmium batteries go 8,000 miles without a drink. Other users are the Southern New England Telephone Company, which has installed them in its new Yale private exchange in New Haven; the Boston and Maine Railroad, which uses them for signalling and crossing-gate equipment; the Pennsylvania Railroad, which has installed them for car air conditioning and Diesel-engine starting; and the New England Power Association, which uses them

for tripping switches in its installations.

Of great interest to the consumer are the tiny cadmium batteries suitable for flashlights, portable radios, and hearing aids. In 1912 the Russians equipped cavalry units with rechargeable cadmium-battery hand lamps for use in making camp. For many years, British miners and policemen have been using similar lamps, which burn for about ten hours on one charge, sell for about $12, and last indefinitely. An engineer in New Jersey has an attractive palm-size cadmium-battery flashlight that he obtained from a German officer after the war. He has used it now and then for two and a half years, and has had it recharged twice. It would be simple to market such a flashlight with a small converter-transformer unit for home recharging.

Like many makers of new equipment, the Easthampton firm's first interest lies in the lucrative industrial market. It is concentrating on batteries for Diesel-engine starting, railroad switching and signalling, car lighting and air conditioning, and for the job the battery was invented for, running fire-detection systems. Plans for entering the automobile field are indefinite, although two car manufacturers are interested. The company is working on a completely new type of nickel-cadmium battery particularly suitable for use in automobiles. The method consists of stamping the battery plates out of powdered nickel and baking them like a batch of cookies. This trick of stamping machine parts in molds from metal powders and baking, or "sintering," them was one of the most dramatic factory developments of the recent war (PS, April '41, p. 98; June, '43, p. 98). It was used to make durable, highly porous tank and machine bearings that soaked up oil like blotters and were permanently self-lubricating. During the war the Germans tried to make battery plates in this manner, but the work was sabotaged by slave labor. Now Andy Langhammer, head of the Chrysler Corporation's Amplex Division and one of the world's leading experts in the powder-metallurgy field, is working with the Easthampton people to make tough, thin nickel plates that look solid but, because of invisible pores, are actually 80% air. These plates are impregnated with the necessary chemicals to make the battery lighter and smaller and to speed up production and reduce labor costs. This sintered-plate battery is now being made in laboratory quantities, and there is plenty of work to do before it is ready for production. When it comes, it may replace one of the most troublesome parts of today's automobile. If it were sold only as optional equipment, many drivers would pay a higher price for the relief it would bring.

Widely used in Europe, as these pamphlets indicate, the nickel-cadmium battery—invented in 1909—was long kept off the American market.

Signal Corps Trying It

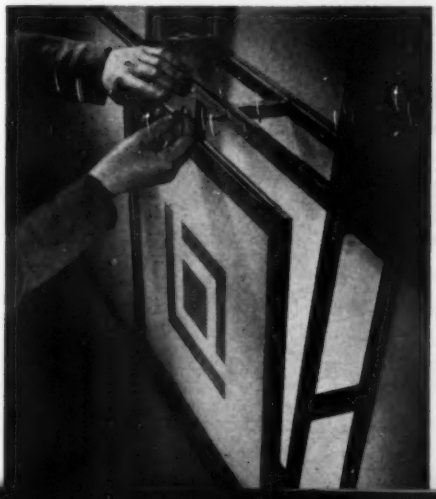
Other American groups are working on the cadmium battery. Baker and Company, Inc., of Newark, N. J., has employed Dr. Anna Hauel, German expert, and is preparing to manufacture it. The U. S. Signal Corps is experimenting with the battery to determine its most effective war uses. Among its military advantages: it can be stockpiled, unlike lead batteries, without attention; it emits no corrosive fumes; and it is so crashproof that it has survived train and airplane wrecks.

But the nickel-cadmium battery will not supplant all other batteries. The lead battery and the dry cell will aways be cheaper and satisfactory for many jobs, and the Edison battery has its own field. Experts say that the cadmium battery is not suitable for electric trucks, in which the storage battery is discharged every day and recharged at night. But, as Europe has shown, it is a superfine tool of many applications, and our government is losing no time in repairing its dangerous ignorance.

America may be 40 years and two wars late in getting this new tool, but her unquestioned genius in production should soon outstrip the world in putting it to work. END

Giant Press Bales Autos

THIS gigantic hydraulic press takes whole auto bodies and in one motion crushes them into neat, bite-size morsels for the scrap-hungry mouths of southern California steel furnaces. Designed to speed the salvage of scrap metal, the huge crusher (above) is six feet wide, five feet deep, and 16½ feet long. It weighs 250 tons and is sunk 30 feet into the ground. Five hydraulic rams inside the press put a 500-ton squeeze on the car bodies and similar-size gulps of scrap and crunch them into small bales measuring 24 x 24 x 56 inches, as can be seen in the foreground above. Recently installed at the A-1 Iron and Metal Company, of South Gate, Calif., the press keeps two clamshell bucket cranes busy feeding it scrap from a five-acre pile. Construction of the giant took two years and cost $100,000.



Glass Blocks Form Wall

ENTIRE walls or partitions of glass can be easily assembled by simply fitting together these interlocking, double-pane blocks. Called Temprex Duo-Pane®, they each consist of two 20-inch-square panes mounted 3⅜ inches apart on a structural aluminum frame. One pane is fixed, the other removable, permitting certain sections to hold knickknack shelves. The glass is five times stronger than ordinary glass and comes clear, diffused, or patterned. Lighting units can be installed inside the wall.

Train's designer, Hawley Bowlus, poses with locomotive and three of its five cars in back yard of his home at San Fernando, Calif., where it's the envy of boys from miles around.

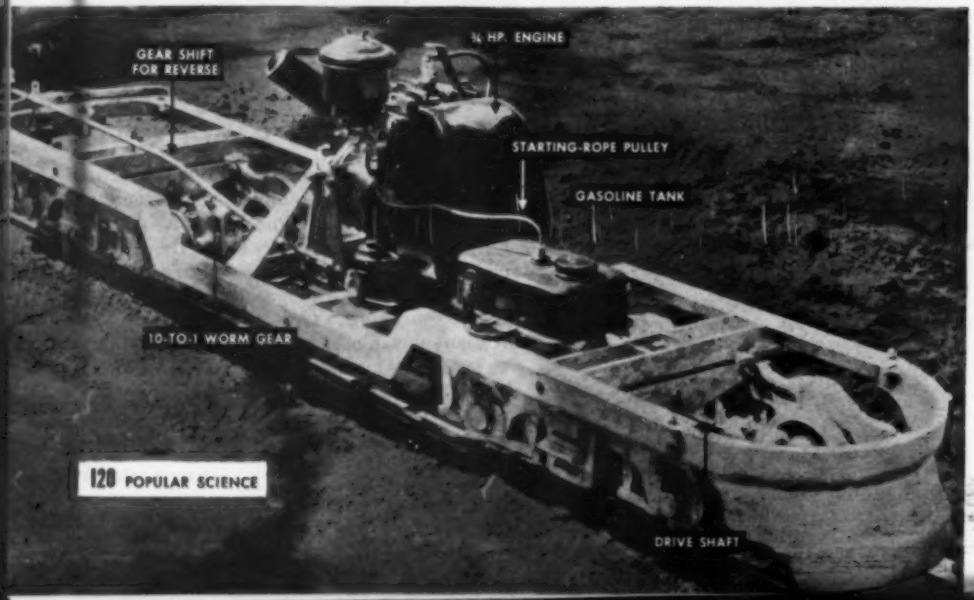
Two boys can ride in each car. Bowlus's son Jack (left), sitting nearest the locomotive but riding backwards, serves as engineer. His brother Charles, facing ahead, is the pilot.

10-Boy Toy Train Goes 12 m.p.h.

HERE'S a toy train that kids can actually climb aboard and ride in. A San Fernando, Calif., manufacturer built it for his two sons. They liked it so well that his company, Bowlus-Robertson, is producing more like it for sale. Price: about $1,400.

Patterned on a Diesel-electric train made by General Motors, the midget travels 12 m.p.h. around 500 feet of 6-inch-gauge track. Its single-cylinder gasoline engine is geared to the 16 drive wheels of a two-section locomotive through a clutch operated by a cable running back to the first car. Pulling the cable starts the train; letting go disengages the clutch, and it rolls to a stop.

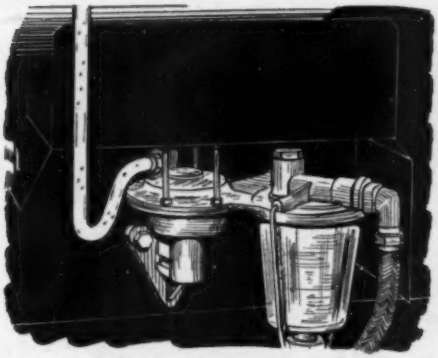
Gasoline engine on front section of locomotive (below) also powers wheels of its rear section.



I'd like to see them make . . .

Everybody has his own pet idea of some gadget he would like to see in general use. What is YOURS? *Popular Science* will pay $5.00 for each one published. Use government postcards only. Contributions cannot be acknowledged or returned.

Safety lighters. A dashboard cigarette lighter—the wireless type—that has the hot element at the end of a cone would let the driver keep his eyes on the road when using it.—*Bradley S. Hart, Rutland, Vt.*



Transparent fuel lines. A clear plastic tube from the pump to the carburetor, preferably with a spinner or streamer inside, would help in troubleshooting auto-engine difficulties.—*M. D. Hernandez, Oxnard, Calif.*

A nursery camera. Baby-safe lighting, a preset fast lens, and remote control to let Pop click the shutter, would give parents a photo of new offspring. Fees could go to the hospital.—*E. N. Dambacher, Jr., North Hollywood, Calif.*

Timer for fans. A time-delay switch would be a boon when you wanted to go to sleep with the fan on but didn't want it to run all night. Just set it to shut off at a certain hour.—*Herbert Browne, Jr., Columbia, S. C.*

Accessory holders. A shoulder cover for each dress with pockets to hold gloves, belt, jewelry, scarf—all accessories for that particular outfit—would be a time-saver.—*Mrs. J. C. Darrah, McPherson, Kan.*

Visitors to the Health Museum can check their weight and height, test their eyesight, and measure their lung capacity. By turning a dial, they can also learn their estimated remaining life span. Other exhibits show circulatory system, food values, how to handle heavy objects.

In Museum shop, an artist-craftsman uses burr to etch "bone texture" into a piece of plastic. When finished, it will be the "bone" part of huge tooth shown assembled on opposite page.

Even electric commutator drums, which turn the lights in the transparent tooth on and off in the proper sequence, are built by Museum technicians. Nothing is bought that can be made.

Self-Service Museum Puts Curiosity to Work

Super-craftsmen at a Cleveland museum are translating health into push buttons—and visitors do the pushing.

By George H. Waltz, Jr.

IN A small, well-equipped workshop just off one of Cleveland's busiest streets, carpenters, artists, and technicians are making health visible. Their shop is part of the famous Cleveland Health Museum. Their job is building unique exhibits for the public to play with—and learn with.

Since the Cleveland Health Museum is a "push-the-button-turn-the-crank" place where the visitors run the exhibits, its workshoppers have to be ingenious. They must tell the story of humans and how they tick, in terms of plaster, wood, metal, plastic, rubber, gears, motors, lights, and wiring. It is work that requires showmanship, medical know-how, and creative skill with tools and paintbrushes. These workshoppers have no ready-cut plans. They must dream up as well as build the exhibits.

They may be called upon to make anything from a realistic, giant-size plastic model of a tooth to a "calorie cafeteria" in which you can learn the energy values of various foods merely by pushing buttons. Their shop is a home craftsman's dream—fine tools and equipment, with every man on the staff an inventor and designer as well as a craftsman.

When the Cleveland Health Museum opened in 1940, it was the first of its kind in the country. Since then, with its exhibits and its reputation growing steadily, it has become a fountainhead—a sort of combination manufacturing plant and lending library—for a new kind of health and hygiene

Plywood frame for plastic tooth is carefully sanded so contours will exactly match those of giant fang. Two rectangular openings hold lighted legends of tooth parts shown in display.

Completed display demonstrates normal tooth construction. Lighted sections show progressively enamel, dentine, pulp, cementum, periodontal membrane, bone, root, crown, and gum.

display. Its craftsmen now devote much of their time to making duplicates of their own original exhibits, either for loan or for sale at cost to schools, county fairs, health organizations, and other museums. By popular demand, they have been forced into the mail-order museum business.

When I visited the workshop a few weeks ago, the men were busy duplicating six of the Museum's dental-health displays for use at the annual meeting of the Southern California State Dental Society. One of their biggest jobs, however, was building exhibits for a new health museum for Bogota, Colombia, S. A. When those displays were ready for shipment, they filled 23 large packing cases and weighed four tons!

Thanks to these craftsmen, the Museum is not a collection of historical relics or a chamber of horrors. It uses clever devices to get across its important story of man and his health. It is visual education at its best. Wherever possible, moving, tri-dimensional displays are used in place of the usual stationary exhibits. There isn't a single "Do Not Touch" sign in the entire building. Anyone can walk up and push buttons, twirl knobs, pull levers, and turn cranks—and the exhibits are built to take it. As a result, the more than 40,000 yearly visitors have as much fun learning about their health and bodies as they would have at an amusement park—and it's all for free.

In spite of the lack of guard rails around the exhibits, the only item that disappears regularly is a ten-penny nail used to illustrate the iron in the human body. Incidentally, because of inflation and the rising costs of chemicals, the workshoppers have to bring this particular exhibit up to date quite frequently. In 1940, when the display was first built, the chemicals that make up the human body could be bought for 98 cents. Today, they are worth $31.04!

Learning By Doing

The Cleveland Health Museum comes by its flair for educational showmanship quite naturally. Its director, Dr. Bruno Gebhard, is a pioneer in finding ways for people to learn by doing as well as seeing. After 10 years with the once famous German Hygiene Museum in Dresden, he came to this country in 1937 as consultant for all the medical and public-health exhibits at the 1937-1940 New York World's Fair. Then, in 1940, when a community-minded group of Clevelanders decided they wanted a different kind of health museum, they chose Dr. Gebhard for the job. That was in June. By November he had his museum in operation. "Most of the exhibits were either borrowed or of the 'five-and-ten-cent' variety," Dr. Gebhard says, as he looks back on it,

Lifelike facial masks for dental-health display are molded from plaster and painted. During 1947 alone, 670 such exhibits, films, and slides were duplicated for 109 other organizations.

"but it was a start, and thanks to our workshop it has grown steadily since."

And the workshop has grown, too. Where the craftsmen once were limited to such materials as wood and plaster, they now lean heavily on newer materials and techniques. With their large collection of plaster molds, they can turn out a realistic arm, leg, or head in transparent plastic. Many of their models—particularly those for use in medical schools—are cast in soft rubber latex and stuffed with cotton so they not only look like the human body but have the flexibility and feel of it.

Realism and the ability to arouse curiosity are the keynote of each exhibit, whether it be a pair of imitation fried eggs or a life-size model of a coughing man that shows how disease germs are spread. These Cleveland craftsmen are experts in the art of sugar-coating the pill of knowledge.

As I left the Museum, I had an idea, and I pass it along for what it is worth. Why couldn't the thousands of home craftsmen all over the country devote part of their time, basement workshops, and ingenuity to building similar visual education exhibits for their own community schools and health groups? Making health visible, as well as other aspects of science, could be an interesting and valuable home-workshop pastime. END

Sunny side up. With a little bit of plaster and paint, the workshoppers can rustle up a mouth-watering pan of fried eggs for a food exhibit that rivals the real thing in appearance.

Correct use of toothbrush is graphically illustrated by this animated exhibit. Turning the crank handle moves the hands, showing proper execution of three basic teeth-cleaning motions.

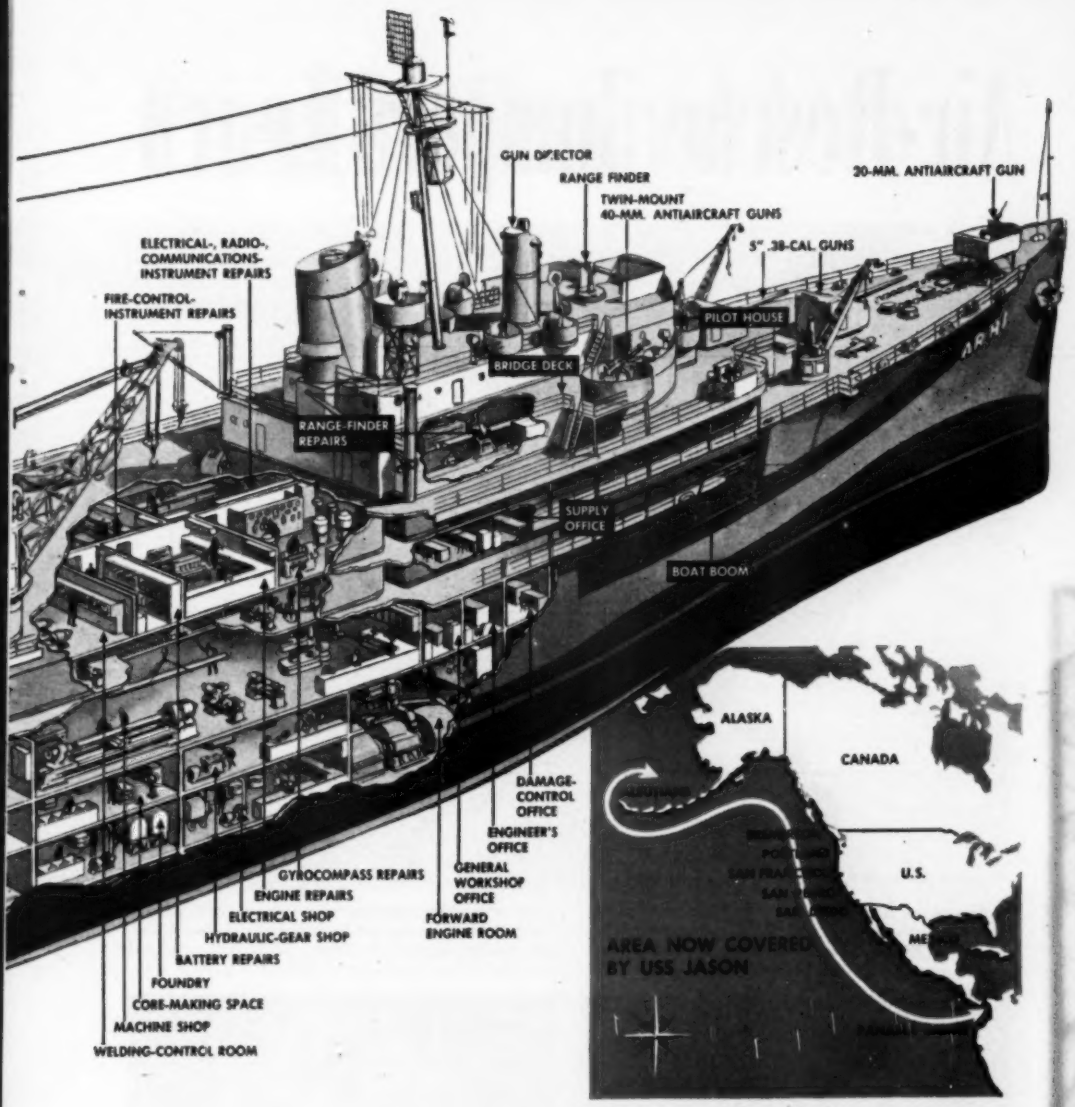
Navy Workshop Follows The Fleet

THIS cutaway drawing takes you on a conducted tour through one of the little-known warships that give the U. S. Fleet its one-two punch.

She's the USS *Jason:* a floating machine shop and hardware store that can steam with a task force into hostile waters and keep fighting ships fit for action, thousands of miles from base.

One of the newest and most elaborately equipped of the Navy's repair ships, the *Jason* was commissioned June 19, 1944, and in the closing months of World War II logged 8,891 on-the-spot repair jobs in the Western Pacific on aircraft carriers, battleships, cruisers, destroyers, and landing craft.

Her official designation, ARH-1, identifies the *Jason* as an auxiliary repair ship,



Repairship *Jason* patrols peacetime beat from Panama Canal to tip of the Aleutian Islands. Based on Terminal Island, California, she carries fuel and supplies for six months at sea.

heavy hulls, and No. 1 of her class. She displaces 16,900 tons, is 530 feet long and 73 feet across the beam, and carries a crew of 640 officers and men.

Regular-stock items in her 50 storerooms range from tiny screws to 6-inch guns and 2-inch armor plate. Six 750-kw. generators provide power to tools for repair jobs down to fixing a watch and up to regunning a destroyer—in fact, for practically anything short of an overhaul in drydock.

Facilities besides those shown in the drawing include an optical shop for repair of binoculars and telescopes, dental and surgical operating rooms and laboratories for treatment of men from vessels without medical service, X-ray darkrooms, and a printing shop. END

Air-Rescue Jumpers Learn

Helicopters like this one, operated by the Air Rescue Service, can snatch a man from the jungle's clutches without even touching the ground. When rough terrain or thick overgrowth make even a vertical landing impossible, they simply hover above the ground while the jungle victims are hauled aboard by rope. Man being helped in above has just been picked up this way.

Getting dinner the hard way. Machete-wielding pararescue trainees first cut down a palm tree, then hack out the heart of the palm cabbage buried in the core at the top of the tree.

Palm cabbage is one of most palatable items on the jungle menu. Other swampland delicacies, less tasty but nutritious, include rattlesnake, water moccasin, wildcat, possum, and alligator.

Primitive Survival Lore

Photos by Mike Ackerman
Acme Newspictures

LAST fall, 15 men bailed out of a disabled B-17 over the dense wilderness of the Nicaraguan jungle. Search parties brought out 14, but the last survivor was so badly injured he couldn't be moved. Then a doctor of the USAF's Air Rescue Service, Capt. Polk Holliday, parachuted to his rescue. He nursed the man for two days until he was strong enough to be picked up by a helicopter. Today that man is alive and well.

Behind this dramatic rescue, only one of more than a hundred in the short, year-and-a-half history of the Air Rescue Service, is the story of a group of men whose sole job is the rescue of crash survivors, explorers, tourists, adventurous kids, and others who may be lost in remote places and require medical aid. The men work in teams of five: one doctor, two medical technicians, and two survival specialists. All are Army-trained jumpers. All are volunteers.

But before these men can help others, they must learn to help themselves. Combining modern science with primitive woodlore, they learn to take care of themselves in jungles, deserts, mountains, and on water.

Probably the toughest part of their eight-week training program is in jungle survival, pictured on these pages. To start with, they jump five times into the Florida Everglades, actually trying to hit the treetops—just for practice—so they can learn how to let themselves safely down. Then comes intensive training in jungle housekeeping—how to protect themselves against insects, purify water, and build shelters of palm fronds. When they've finished this, together with training in desert, mountain, and sea rescues, they're ready for anything.

There are nine such pararescue units now in the U. S., and overseas units are located in Saudi Arabia, Libya, Bermuda, the Azores, Labrador, and Newfoundland.

The exploit the Air Rescue people are proudest of took place last winter in Labrador. On December 9th, a C-47 with 29 persons crashed only eight miles from Goose Bay. A ground rescue party set out on the 10th. The same day, Lt. Stanley Bear, a paradoctor, left Pope Field, N. C., by air for Goose Bay. On the 11th, a helicopter landed him on a frozen lake near the wreck. From there, he trekked to the plane, arriving three hours before the ground party.

Only six of the victims were alive, but all were evacuated by air and all survived. Lt. Bear had come all the way from North Carolina in less time than it took the ground party to travel about eight miles!

One of first jobs during jungle training is construction of a dispensary consisting of log framework covered with palm fronds. A cot for the dispensary will also be made of palm fronds.

All sleeping is done in tree-slung hammocks, as ground is often wet and swampy. This also offers best protection against prowling snakes. Awning over hammock helps keep sleeper dry.

Snakes are plentiful in the Everglades, so pararescue trainees must learn how to catch and kill them safely. Strapped to palm stems and baked, they make good eating—some say.

Head of dead water moccasin is milked to remove poison from fangs. Note that medic in foreground is wearing gloves. The deadly poison is still active even though snake has been killed.

Cooking and eating utensils are fashioned out of bamboo. Hollow sections form natural drinking cups; split sections make scoops and ladles—but other items require more ingenuity.

Moist and fire-resistant, bamboo utensils can actually be used to cook food or boil water over a fire. To save time and work, the men eat from the same utensils in which the food was cooked.

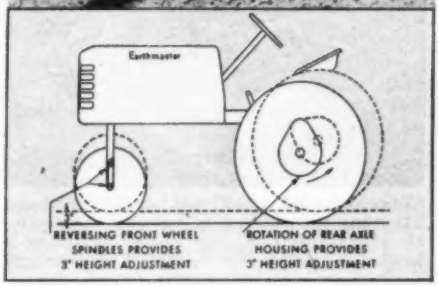
Getting ready for a jump, a pararescuer climbs into an outfit designed especially for landings in dense jungle. Heavy suit, high collar, and helmet protect him against scratches from sharp branches. Rope at his waist will help lower him to the ground if he lands in a tree. Note large pocket on his right leg to hold the rope coil.

Tractor Has Rear Engine

ALLIS-CHALMERS has put the cart before the horse in this new farm tractor. Placing the engine behind the seat and mounting implements under the driver, between the front and rear wheels, give him a clear view of his work and make possible the precision tillage needed for truck farming.

For use with the tractor, called Model G ⓣ, the manufacturer has brought out a new line of cultivators and seeders. These range from a single 12-inch moldboard plow to the multirow seeder shown above. Any of them can be hooked on in five minutes.

All controls except steering are behind the junction of the main trunk and the high-arching wishbone that carries the detachable implements. It would be possible, therefore, to disconnect the power and traction elements from the rest of the tractor and attach them as a driving unit to larger field machines. Steering then would be done by the tractor's individual-wheel brakes.

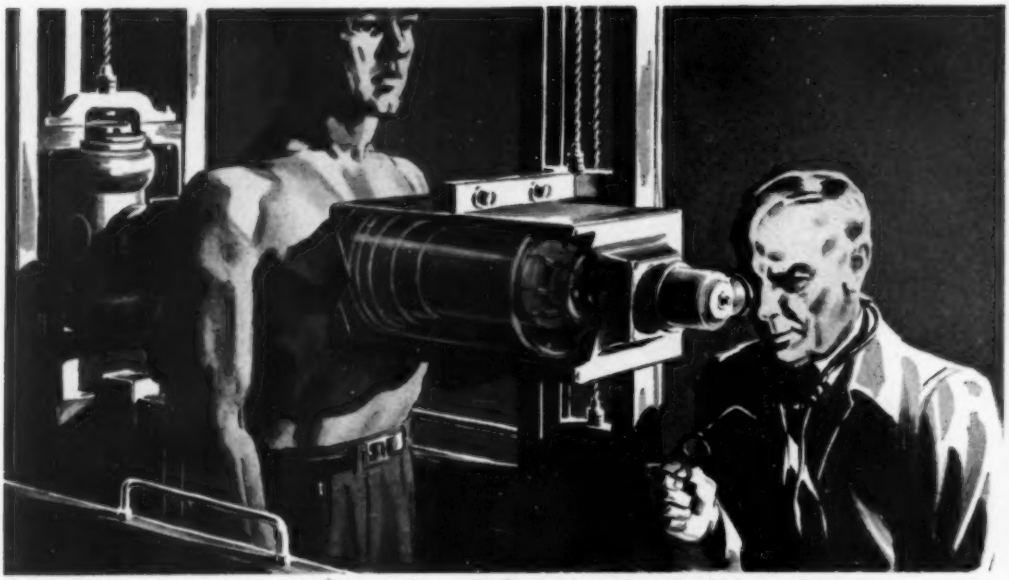


This One Carries Stilts

THE Earthmaster ⓣ tractor at left can grow up with the crops it cultivates. Its ground clearance is increased from 18 to 21 inches by lowering the wheels in relation to the body. To do this, the front wheels are mounted on reversible spindles, while the axle housing of the rear wheels can be pivoted around the drive shaft for adjustment. Bigger tires can add another 3½ inches.

Gauge Fits Oil Drum

THE Tru-Oil-Gage ⓣ at right shows at a glance how much oil remains in a 55-gallon drum. The indicator is a cork floating in a plastic tube at the level of the oil in the drum. The top of gauge grips the drum's rim; the bottom screws into the head.



Doctor looking into electron fluoroscope has a brilliant view of patient's internal organs.

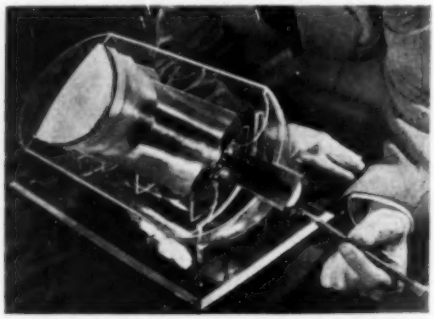
Electrons Now Brighten X Rays

WHEN a doctor gives you an X-ray examination with a conventional fluoroscope, he sees a dim, greenish-yellow-and-black image on the viewing screen. It is so faint that making out fine details of your internal organs in action is like trying to read a newspaper by moonlight. Soon, however, he can use a new X-ray viewer whose effect in brightening the image is comparable to turning a spotlight on the newspaper.

This instrument, which will amplify the brightness of the image 500 times, is an electron fluoroscope—a new electronic tube—developed by Westinghouse engineers.

With this enormous step-up in the brightness of fluoroscope views, faint clues to

Pioneer form of electron fluoroscope, above, proved the idea would work. It produced an image of five times the normal brightness upon the circular white screen at its nearer end.



Cutaway model shows latest type of instrument. Electrons from screen at far end, accelerated by 20,000-volt kick, give image 500 times as bright on small screen indicated at near end.

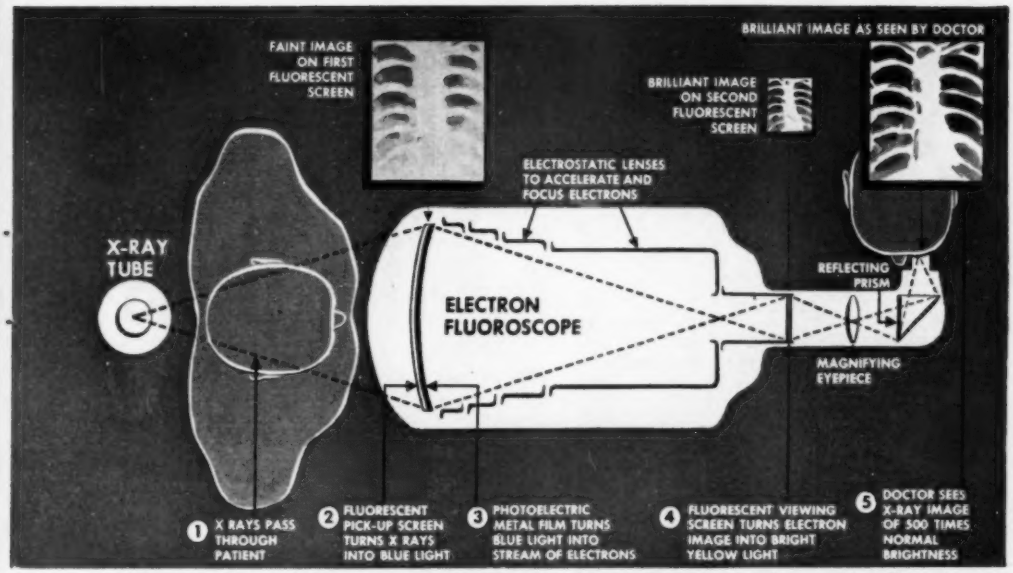


Diagram of the electron fluoroscope shows how it amplifies the brightness of an X-ray image.

disease—which formerly could be confirmed only by studying X-ray films—stand out prominently. In a few minutes of direct examination, a doctor may obtain as complete a picture as he could get from scores of X-ray pictures taken from various angles.

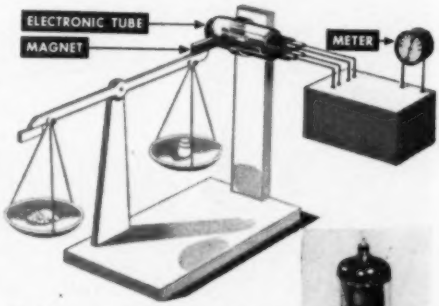
The principle applied by the electron fluoroscope is that used by the wartime "sniperscope" for seeing in the dark.

How it works is shown in the diagram above. An X-ray image is formed on the first of two fluorescent screens in the usual way, exposing the patient to no more than the usual amount of X rays. The back of this first screen, however, is coated with a photo-sensitive film of cesium-antimony alloy. This gives off a pattern of electrons that conforms in shape and intensity to the fluorescent image. These electrons, accelerated by a 20,000-volt kick and focused by electrostatic lenses, then smash into a second fluorescent screen at 5,000 miles a second. There they produce a brilliant final image—even bright enough to be televised.

Thus the day may come when a doctor may call medical specialists hundreds of miles away into immediate consultation during his examination of a patient. END

Tube Detects Movement

A NEW electronic tube no bigger than a walnut can measure the slightest movement of objects as small as the hairspring of a watch. The object over which it "stands guard" must first be magnetized or have a magnet attached to it, as in the sketch at right. Any movement of the magnetic field then is detected by the change in its pull on a stream of electrons flowing through the tube. This change can be signaled either to a meter or to a motor that moves a second object to follow the first one. Eastman Kodak Co. developed the tube during the war to help aim antiaircraft guns.



Tube can tell when delicate scale is unbalanced by feeling the shift up or down of the pull of magnet on crossbar.

"Traffic cop" along desert speedway sits in airplane seat on 12½-ft. tripod. He has red signal light to warn drivers of impending mishaps.

Gunning the Hot Rods

By Andrew R. Boone

BILL BURKE is an Alhambra, Calif., welder; Don Francisco, a city fireman. They're not sure just what their car is: it has the chassis and running gear of a Ford roadster, a Mercury engine, and a body made from the wing tank of a P-38 fighter plane. They put it together themselves, and in it Burke recently whizzed along a stretch of the Mojave Desert at 149.75 miles an hour.

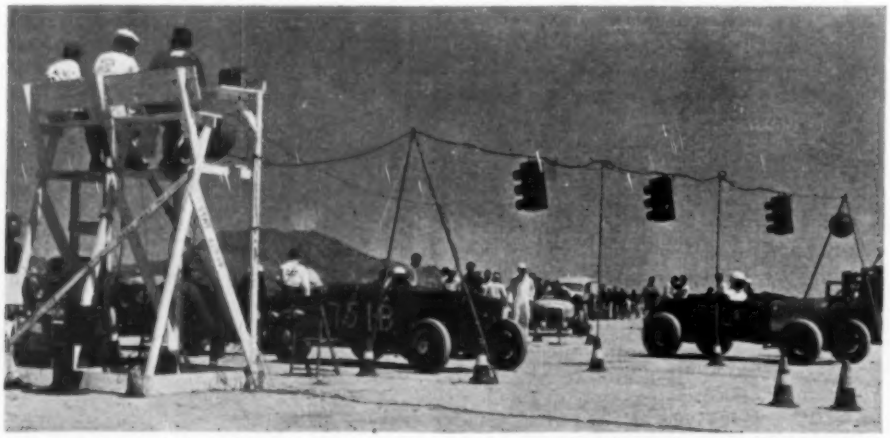
That's the current record of the Southern California Timing Assn., at whose speed trials every week end some 250 hybrid jaloppies like Burke's go screaming over the hard, smooth bed of El Mirage dry lake. It won't stand long if the drivers of these hot rods—as they're called—keep on thinking up new tricks to streamline a racing car and jazz up its engine.

Many of the drivers are ex-GIs who learned how to doctor engines while repairing jeeps, tanks, and airplanes at bases around the world (PS, April '46, p. 134). In the last year they have added an average of about 10 m.p.h. to the top speeds of their patchwork racers.

To keep pace with their growing numbers and their steady push toward the 150-m.p.h. mark, the association has installed an elaborate speedway traffic system and an electronic timer that clocks the cars over a measured quarter-mile course to 1/1,000 of a second.

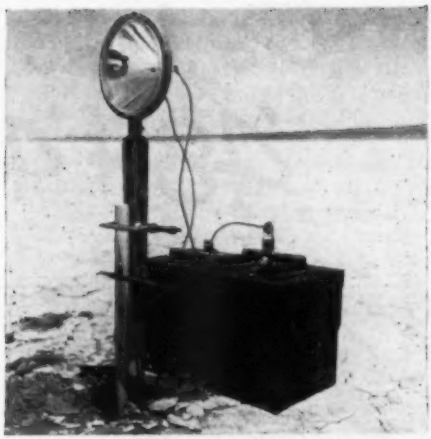
And after the hot rods hit 150?

"Up to 160—we hope," says Wally Parks, club secretary. He figures that dream may come true by 1950.



Starting lights flash red, amber, and green signals in succession to send cars out of three lanes at 20-second intervals on 1½-mile approach to their carefully timed runs through speed trap. As many as 250 hot rods may make 500 starts on a week end. Starters get reports by phone from patrol judges and timers, and direct cars to the starting line by a loudspeaker system.

Electronic stop watch, calibrated to 1/1,000 of a second, times hot rods during speed runs. Shown with the apparatus is man who designed it, J. Otto Crocker, a San Diego bank technician.



Clock starts when car breaks beam from spotlight (above) to photoelectric cell at start of ¼-mile course. Breaking a second beam at finish line stops clock, which then shows elapsed time.

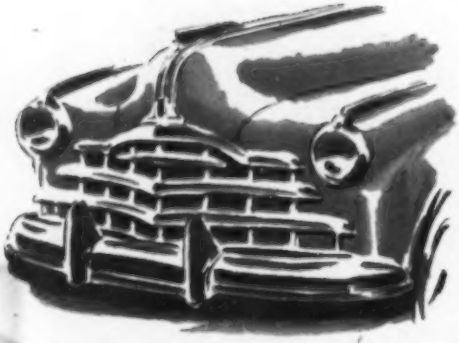
Hot rod is started by towing it with another car. Towline is attached to right front axle with airplane seat strap that can be unhooked while in motion by a tug on cord running to tow car.

Rear-engine speedster gets a push start. It has 1937 Cadillac V-8 motor mounted on the body of a 1923 Dodge roadster. Streamlined nose is a war-surplus wing tank cut in half.

Radiator is eliminated to sharpen nose of this model. Instead, it has a 10-gallon water tank behind engine. Car is drained after each run and takes an hour and a half to cool off.

Half the hot rods now burn alcohol instead of gasoline. This one carries its 5-gallon supply in an aircraft oxygen bottle. At better than 100 m.p.h., car gets about two miles to a gallon.

Do You Know Your '48 & '49 Cars?



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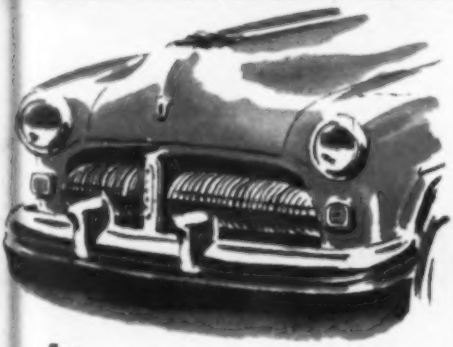

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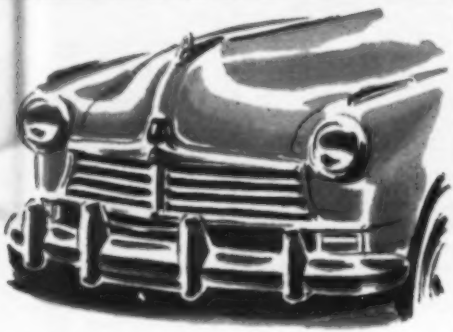

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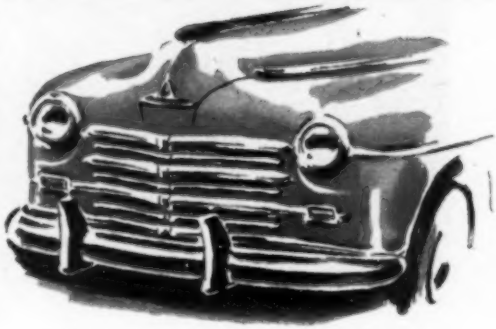

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WHAT new automobile has a T-shaped piece of chrome on its grille? If you've kept up with car styles, that's a feature you'll look for in identifying one 1948 model.

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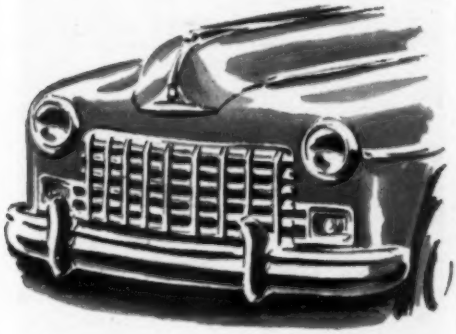

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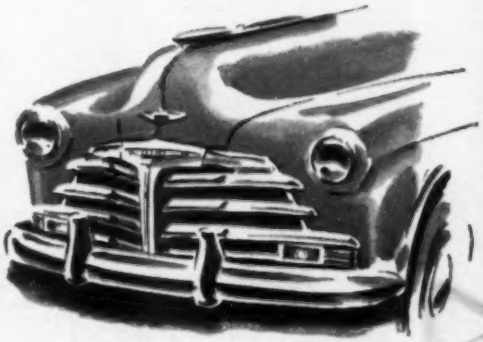

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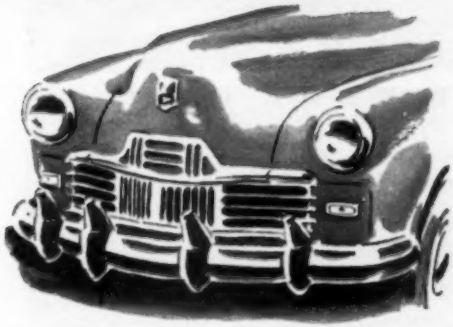

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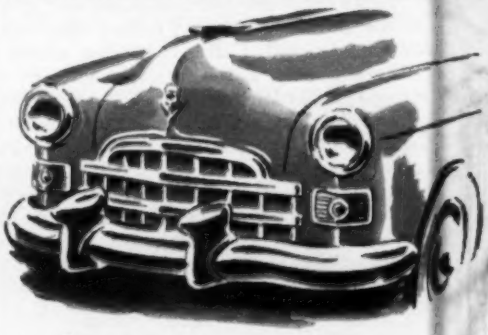

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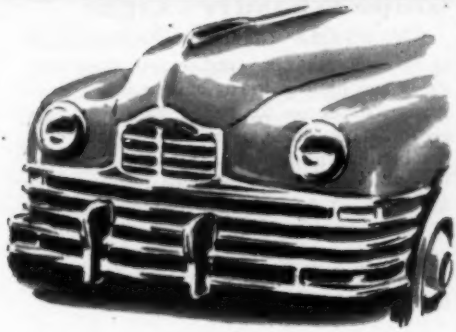

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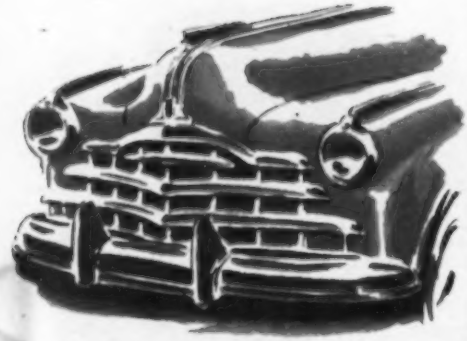
Do You Know Your '48 & '49 Cars?



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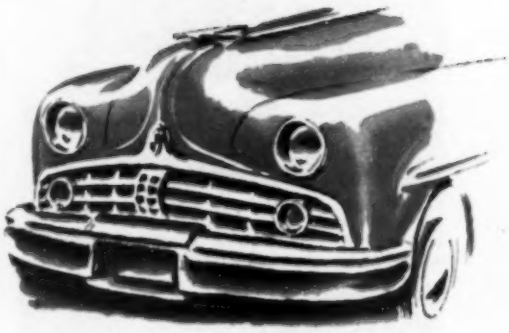

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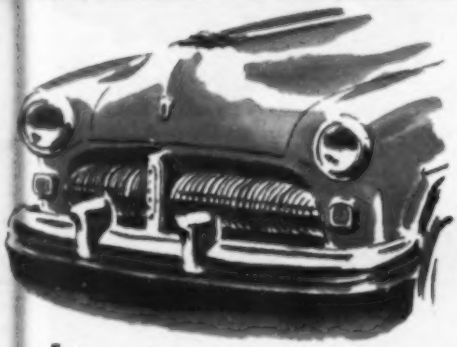

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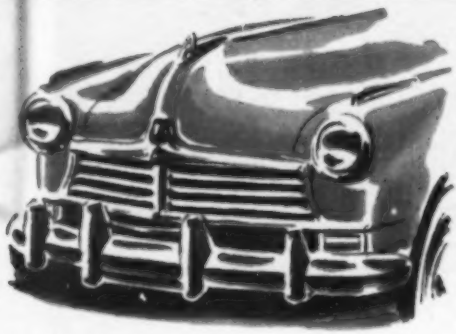

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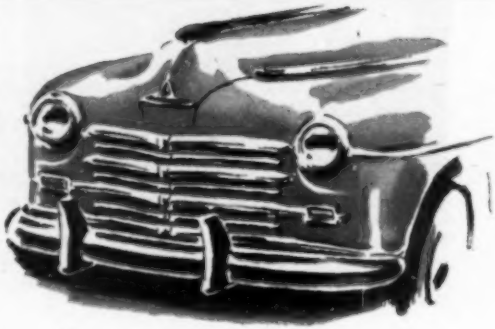

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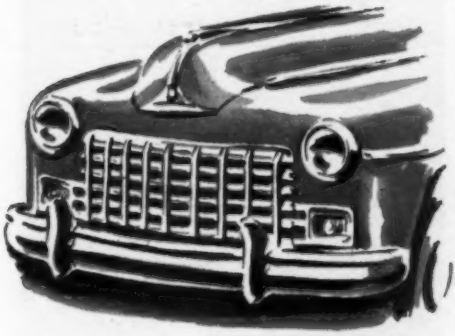

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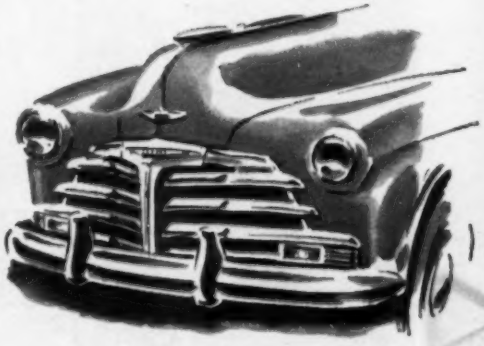

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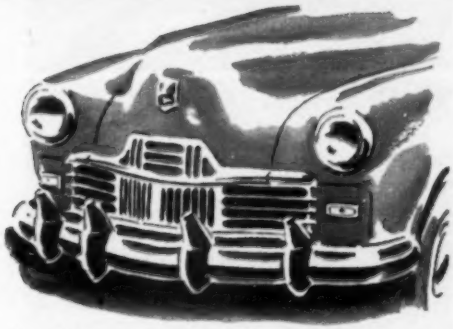

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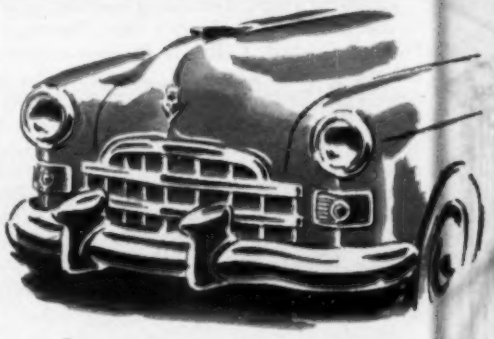

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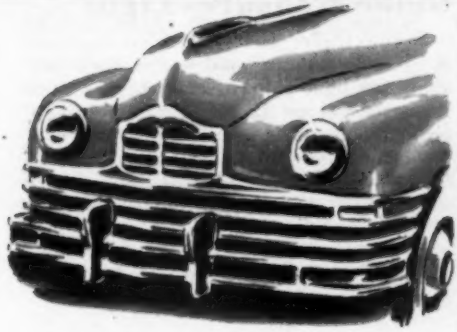

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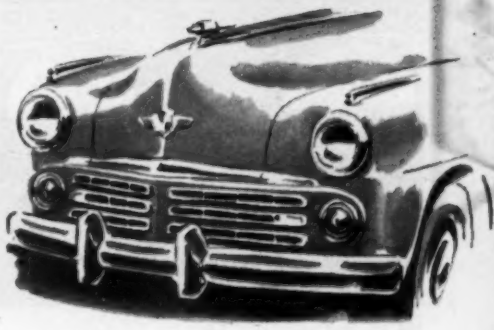

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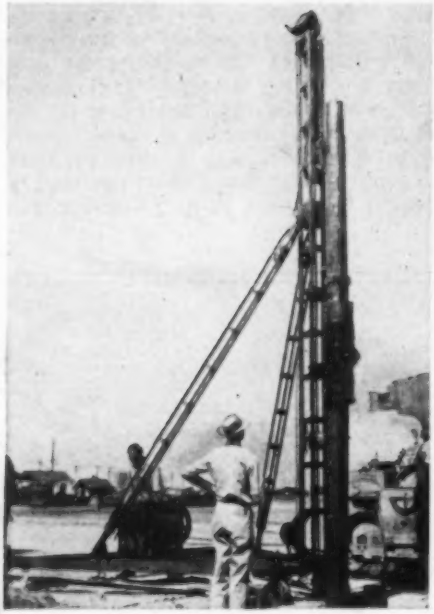
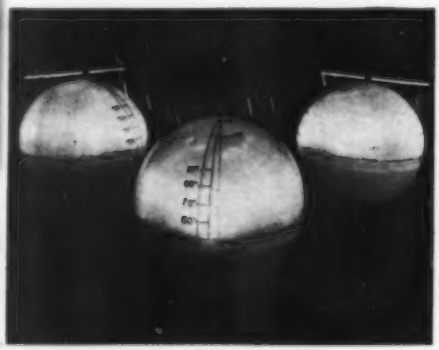


Pile Driver Runs Itself

THIS lightweight German pile driver, now in use at the U. S. Navy's Port Hueneme Proving Ground, Calif., is its own engine. Weighing only a ton, it is essentially a single-cylinder Diesel engine, with the 1,100-pound hammer acting as a piston. As the hammer falls to drive the pile, it compresses vaporized Diesel-oil fuel in a cylinder until spontaneous ignition occurs. The explosion drives the hammer back up again, and the cycle is repeated. For the first stroke the hammer is hauled up by a hand winch, after which the action is automatic. The hammer hits only about 50 strokes a minute but can drive piles that will support a 25-ton load.

To Warm or Cool You

HAVE a fevered brow you want cooled? Or a tummy ache you want warmed? Either one is possible with this combination ice pack and hot-water bottle. Called Hot-R-Cold Pak Ⓣ, it is a folding, wallet-size, plastic pouch containing a special liquid that stays either hot or cold for a long time. For an ice pack, you simply chill it awhile in a refrigerator; for a hot-water bottle, heat it in hot water.

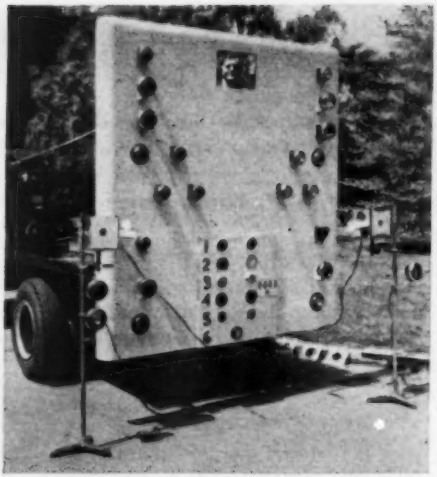


Globe Measures Light

SEEING triple? That's just what engineers at Sylvania Electric want to see when they study the light patterns of lens-type lamps whose beams are too broad for screen projection. They place an opal-glass globe over the lamp to be tested and then put mirrors behind it on both sides. This produces the arrangement shown at left and lets them see all sides of the globe at once. The globe, graduated in degrees, shows at just what angle the greatest amount of light is concentrated—in this case at about 72°.

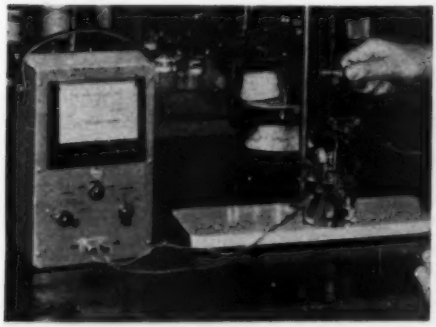
"Hat" Maps Head Shapes

No, THIS isn't a new creation in ladies' hats—it's Bell Telephone Laboratories' latest gadget for getting the head sizes of its telephone operators. The graduated rods around the semicircular headpiece produce accurate contour maps of any head shapes. From these, Bell will design better-fitting, more comfortable earphone headbands.



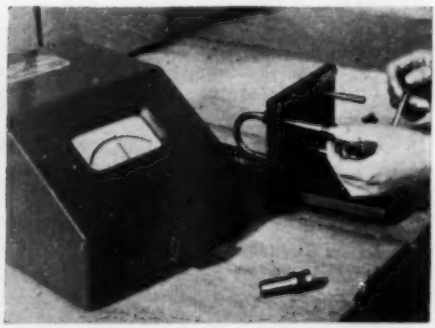
Panel Tests Truck Lights

YOU won't see a truck on the road with quite as many rear lights as this one has. Thanks to it, however, "stop" and "turn" signals on other trucks may be improved. General Electric designed the panel to test lights of various colors and brightness. The operator (at porthole) can turn them on singly or in any combination for viewing.



Billionth Amp Metered

CURRENTS as small as a billionth of an ampere can be measured with a new RCA microammeter, shown above, designed for such ultra-sensitive jobs as gauging the light emitted by stars. The portable instrument covers the range from a billionth to a thousandth of an ampere. It can be converted to a high-resistance voltmeter or a high-range ohmmeter. Though sensitive, it withstands a 10,000 percent overload.



Millionth Inch Gauged

HOLES too small to be measured with ordinary tools can now be gauged with this British device that shoots compressed air through them. The instrument actually measures how much an electric filament is cooled by an air stream escaping through the test hole. It compares this cooling effect to that of an air stream sent through a hole of known size. The makers claim the gauge feels differences of a millionth of an inch.

Sun's Daily Signals

Short-range predictions based on a new discovery enable the world's radio stations to counter magnetic storms.

By Alden P. Armagnac

FROM an office-building rooftop amid New York's downtown skyscrapers, J. H. Nelson, radio engineer and official sunspot observer for RCA Communications, Inc., scans the solar disk daily through a six-inch telescope. Making penciled dots on a circular chart, he carefully notes the position of blemishes upon the sun's face. Then he descends to an office where he dictates a brief message to his secretary. Within a few minutes, RCA's powerful transmitters are forewarning commercial stations all over the

In observatory atop a New York building, RCA's J. H. Nelson prepares for a look at the sun.

Direct Radio Traffic

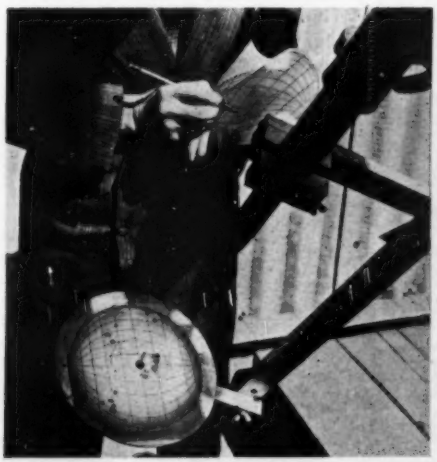
world of what radio reception will be like within the next 24 hours, so that they can plan their schedules accordingly.

If the bulletin predicts an imminent magnetic storm that will turn shortwave messages into unintelligible gibberish—like a teletype machine gone haywire—San Francisco, London, Tangier, and other key stations have time to open up extra transmitting channels and get the messages through ahead of the storm. If it warns that a regular radio route will be particularly hard hit, engineers can warm up a "detour."

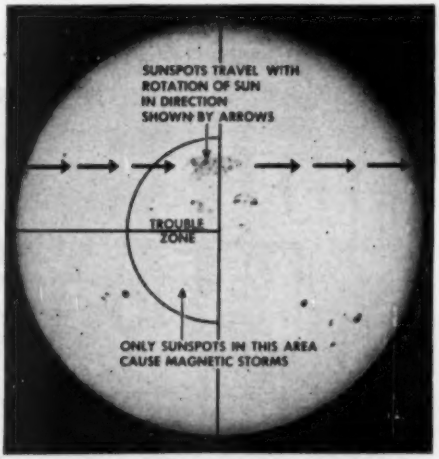
Scientists long have known that sunspots brew the earth's magnetic storms and create disturbances in the radio-wave-reflecting layer of the earth's atmosphere, called the ionosphere, that aids long-distance transmission. Long-range forecasts based on 11-year sunspot cycles, issued for some time by the National Bureau of Standards, have already been providing valuable advance information on the frequencies likely to be least adversely affected three months hence. Now, RCA announces after months of successful trials, a way has been found to make accurate predictions of "radio weather" at short range—just a few hours in advance. This method has been developed by Nelson, in collaboration with H. E. Hallborg, research engineer, and Miss Audrey Arzinger of RCA Laboratories, as an outgrowth of sunspot observations that Nelson made as an amateur astronomer in 1946 and 1947.

Sunspots, he has found, play hob with radio only when they drift across one particular part of the sun's face. This trouble spot, less than 1/10 as large as the sun's whole disk, has the shape of a half circle. Its straight side passes through the sun's center. The curved side faces the direction from which sunspots come. As they enter the semicircle, their mischief begins; as they leave, it ends. Since sunspots travel with the rotation of the sun, which revolves once in 27 days, movement of an individual sunspot can be predicted with great accuracy. Nelson has been able to forecast magnetic storms interrupting radio transmission to within 15 minutes of the time they actually occurred.

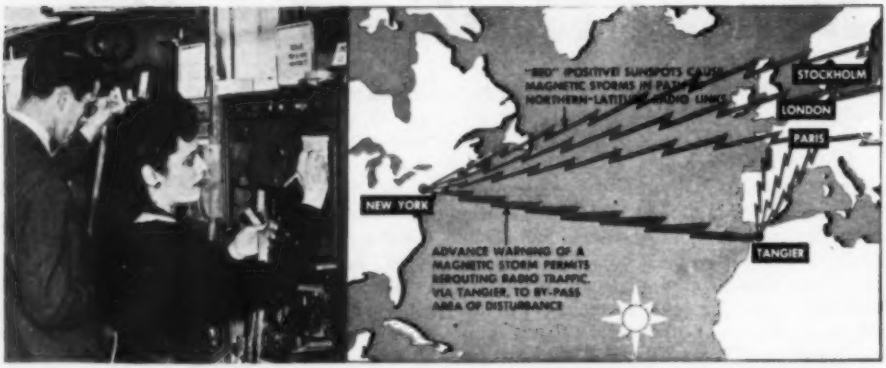
Aided by reports from Mt. Wilson Observatory in California—which classify the sunspots he is watching as "red" or "violet," according to a shift observed in their spectral lines—Nelson can even tell where the disturbance on earth will be most severe. "Red" sunspots, which are electrically positive, affect radio in the upper latitudes of the Northern Hemisphere. "Violet" sun-



Projected image of sun's disk, on chart at end of telescope, shows sunspots as black specks. Here, Nelson uses duplicate chart to note their position, on which he bases the day's prediction.



New forecasting method results from Nelson's discovery that sunspots, seen above, affect radio only while they are passing through semicircular "trouble zone" near sun's center.



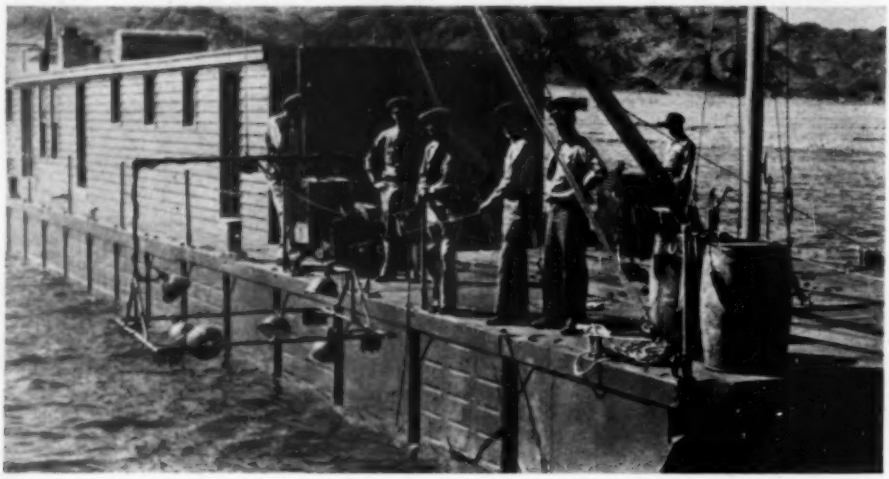
When magnetic storm hits North Atlantic, radio messages flow on without interruption via "detour" shown on map. Alerted by Nelson's advance warning, Tangier goes into action as relay for Europe-U. S. traffic. In foreground of photo, above left, a high-speed transmitter-receiver at RCA's New York headquarters is exchanging 480 words a minute with Tangier.

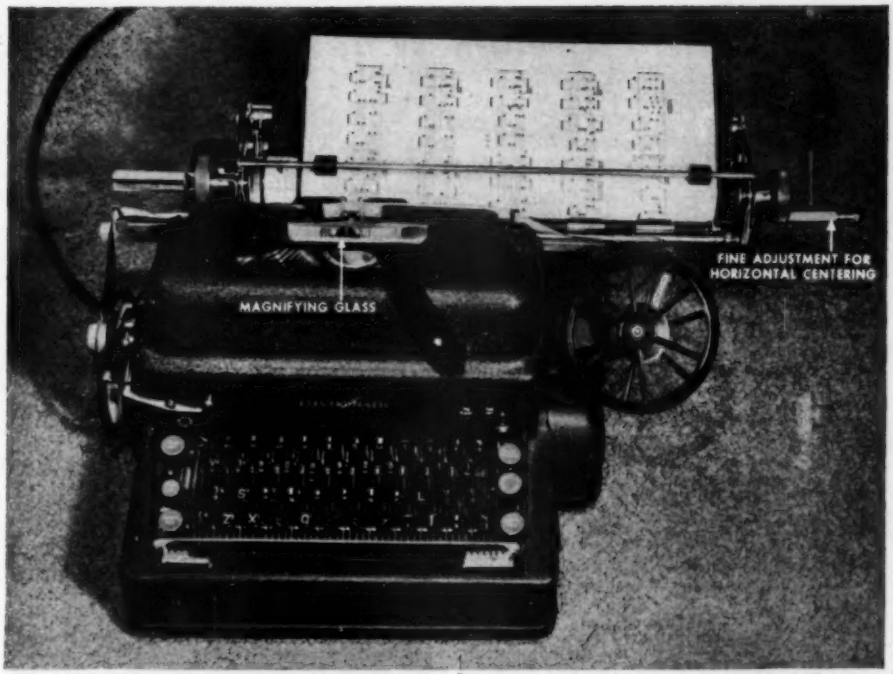
spots, electrically negative, strike hardest in corresponding latitudes of the Southern Hemisphere.

Knowing that a northern-latitude storm is about to cut direct, great-circle transatlantic links between Europe and America, RCA's New York headquarters can prepare to reroute its radio traffic around the trouble area by way of Tangier, in North Africa. A flash to the Tangier supervisor gives him ample warning to call in extra help, man additional transmitters and receivers, tune in European signals, and have them ready on automatic relays as New York calls for them. Thanks to a former amateur astronomer's glimpse through a telescope, the stream of news and urgent business messages flows on without a ripple. END

Navy Films Lake Bottom

USING the self-propelled barge and the photoflash-bulb rig shown below, Navy photographers are studying a submarine dust bowl—Lake Mead, backed up by Boulder Dam on the Colorado River. Photos taken with underwater cameras show them how fast the silt dumped there by incoming water, an estimated 1,400 carloads daily, is robbing the reservoir of water-storage capacity. Their films and core samples to identify the source of the mud will guide them in planning preventive measures.



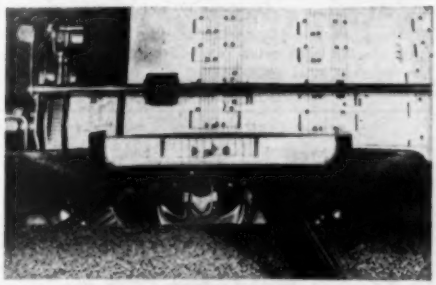


New music typewriter is standard IBM machine with special keyboard and type bars to make musical characters. Typist inserts ruled paper edgewise and works down the columns from the upper right. Fine horizontal adjustment helps center notes on or between lines of the staff.

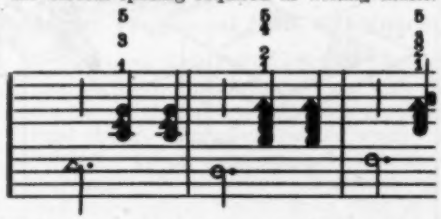
Machine Types Simplified Music

DOZENS of inventors have wrestled with the problem of devising a typewriter to write music. None so far has come up with a solution simple enough to displace the pen-and-ink hand method still used by commercial publishers. Failure by others, however, hasn't daunted Dr. Floyd Firestone, Washington acoustical engineer, who has invented the music typewriter pictured at the top of this page.

Dr. Firestone has attacked the problem through the back door: he first worked out a simpler way of writing music—then designed a machine to write it that way. His system of notation differs from standard style mainly in getting rid of the key signature. This is done by translating all sharps into flats, and identifying all flats individually by writing them as triangular-shaped notes. He says this makes music easier to read as well as simpler to write.



Prism magnifier, made by splitting an ordinary reading glass and bolting it to the typewriter, aids typist in adjusting the carriage for the careful spacing required in writing music.



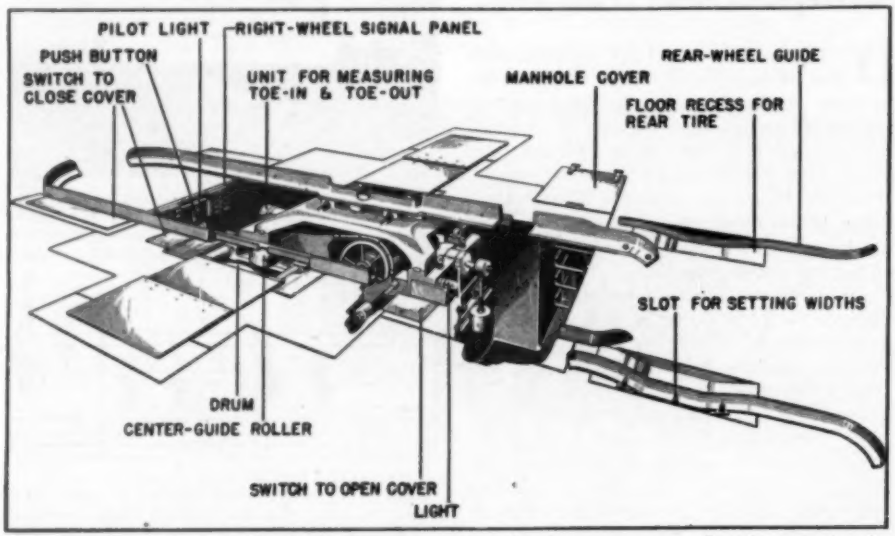
Music written on typewriter has no key signature. Instead, triangular notes indicate black keys on a piano; round notes, the white keys.

New Gauge Speeds Wheel Alignment

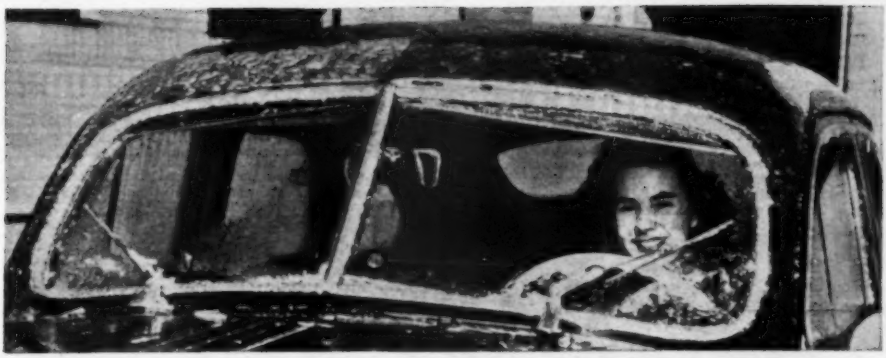
ALIGNING a car's front wheels is a precision job. The best way to see whether they're exactly right is to measure how they behave when spinning at road speed with the car's weight on them. A device that does this in 20 seconds has been developed by the Ford Motor Co. and installed as the last stop on assembly lines now turning out its '49 models. On this roadability gauge a car's front wheels rest on two motor-driven spherical drums that spin them at 30 m.p.h. Their side thrust, if any, registers on a panel in colored lights—yellow for toe-in, green for toe-out—to guide adjustments.

New Mercury is driven onto roadability gauge. As front wheels approach pit, weight of car will slide covers back from powered drums on which the wheels will rest during the alignment test.

Operator makes adjustments to correct side-thrust of wheels indicated by flashing of colored lights on panel in front of him during test run. Gauge tests both front wheels at same time.



Cutaway view of new Ford wheel-alignment gauge shows arrangement of main parts in pit.

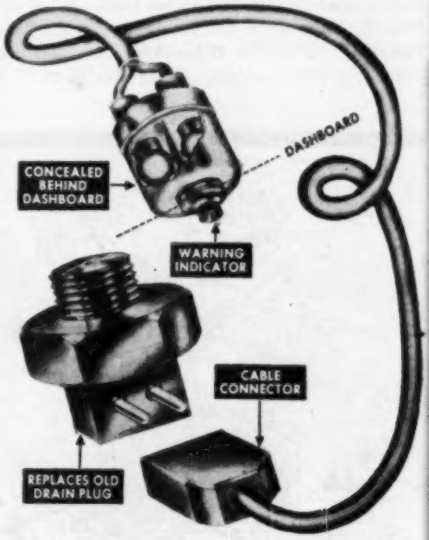


Windshield of Conducting Glass Melts Off Ice

ICED windshields may seem no problem as yet, but with an eye to winter, Libbey-Owens-Ford Glass Co. is developing electrically heated ones. Perfected for war use, the safety-glass sandwich has an almost invisible film of stannic oxide on an inside surface. This conducts electricity, generating heat said to keep the glass ice-free in subzero temperatures. As it requires higher voltages than passenger cars now have, it may appear first on trucks, buses, and police cars with AC radio generators.

Rear-Engine Car Has No Body

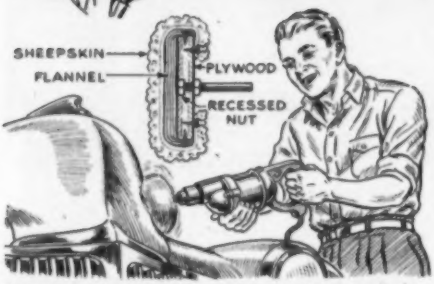
AN UNUSUAL feature of this 500-lb. racer is the front spring assembly, giving knee action through an overhead transverse spring from which the chassis is slung. The car, built by the Monaco Motor and Engineering Co., Watford, England, has a wheel base of only 5′. Rear wheels are 3′ apart and front wheels 3′ 10″ apart. The rear-mounted Racing Norton engine develops 45 hp. It is not supercharged. A maximum speed of 100 m.p.h. is claimed for the midget, which was designed for short-distance racing. The Monaco has no body—it's just a chassis and power plant.



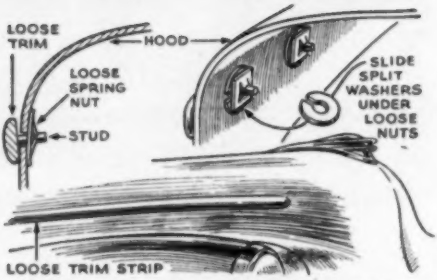
Light Warns of Low Oil Supply

AN AMBER dash light flashes on when engine oil drops 1 qt. below normal with this device. If the oil level drops 2 qt., a red light shines. Operating by the weight or head of oil in the crankcase on a resilient diaphragm, the Oil-Dicator ⓣ consists of a unit that replaces the oil drain plug and a dash fitting. Retailing at $7.95, it's made by the Parkwood Mfg. Co., Haddon Heights, N. J.

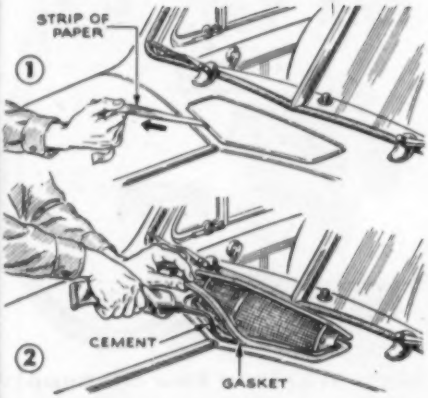
Hints From the Model Garage



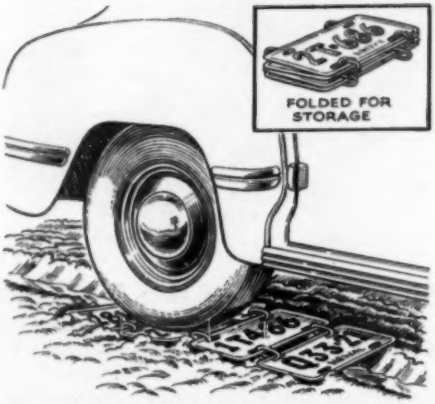
Make Your Own Polishing Pad. If you own an electric drill, it's a simple job to assemble a polishing attachment. Cut a 5″ disk from ½″ plywood, drill and counterbore it, and attach a shaft cut from a ¼″ bolt. Pad the face with several layers of flannel. Finish it off with sheepskin cut from a polishing mitt, tacking along the back.



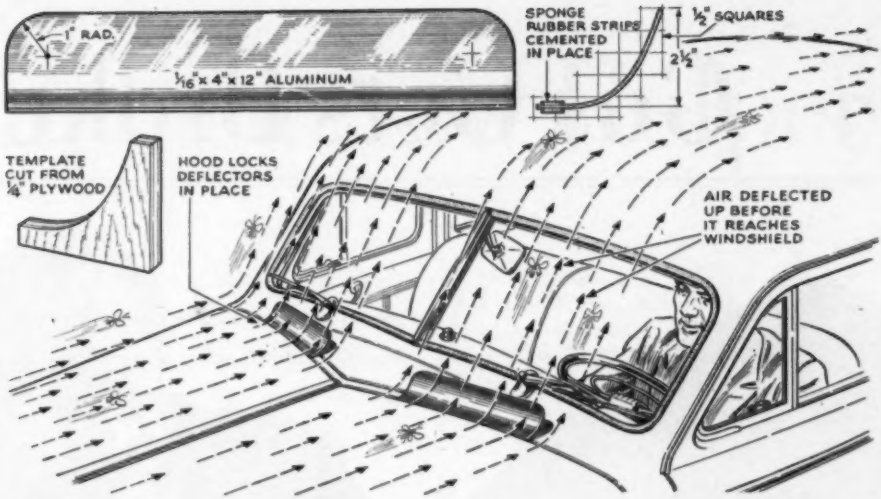
Washers Tighten Trim. Chromium trim often is attached with unthreaded studs and flat spring nuts. In time, wear on the studs may loosen the nuts and allow the trim to rattle and squeak. One way of tightening it is suggested above. Cut a section from a steel washer. Then force the washer behind the nut to take up the slack.



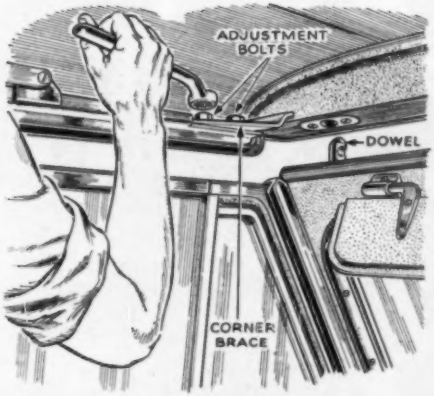
Repairing a Cowl Ventilator. Water may leak through a cowl ventilator unless the lid makes firm and even contact with the gasket. If a strip of paper can be withdrawn when the lid is closed on it (1), increase the lid tension by shortening the adjusting link you'll find under the instrument panel. It's also sometimes helpful to remove the gasket, clean it and its channel, and carefully cement in place (2).



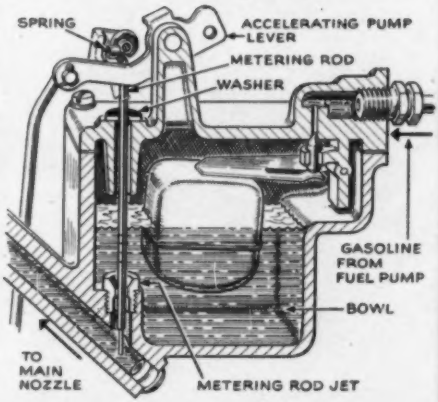
Plates Get You Out of Mud. What do you do with your old license plates? Throw them away? Tack them on the garage wall? Herman Marcus, of Jamaica, N. Y., has a better idea. Link at least four of them together, using wire or perhaps chain-repairing links, fold them into a compact bundle, and store in the luggage compartment. Then if you ever get stuck in the mud, you've got a ready-made mud track.



Bugs Kept Off Windshield. At this season, the spatter and smear of insects on a windshield makes seeing tough, especially at night. A. W. Schach, of Rockford, Ill., uses deflectors like these to overcome the problem. The sketch on ½" squares shows the curvature that will deflect air over the roofs of most modern cars. Cut a plywood template to this curvature as a guide when bending the aluminum. Either polish the aluminum to a high luster or paint it to match the car.



Adjusting a Folding Top. Convertible tops on General Motors cars may be adjusted either forward or back if the dowels don't hit their holes in the roof rail. First, unlatch the top and raise it slightly. Next, loosen the adjustment bolts. Then move the corner brace until the dowels and holes are properly aligned. In some cars, a different corner brace is used, but the adjustment is essentially the same.



Carburetor Service Tip. In a modern carburetor of the metering-rod type, the little spring at the top of the metering rod and the sealing washer are points that occasionally give trouble. If the spring is missing, the rod may vibrate sufficiently to unseat the washer. This admits full atmospheric pressure to the chamber. Rough engine performance or high fuel consumption may sometimes be traced to this.

Gus Gets Broken

in by a New Helper

When Stan Hicks graduates to a full-fledged mechanic and a new grease monkey comes to the Model Garage, time hangs heavy on extra hands.

By Martin Bunn

The inner side of the radiator was badly gashed. It looked as if the harm had been done by the fan blades.

"HEY, mister—what should I do now?" Gus Wilson, flat on his back under the jacked-up rear end of George Knowles's car, looked up at Greg Jones, the Model Garage's new grease monkey. "Well," he suggested, "you might sweep out the shop."

"I've done that," Greg told him.

Gus slid out from under the car and looked around. The floor had been swept thoroughly and the waste boxes had been emptied. As far as he could see, all the routine Monday-morning jobs had been well done. He glanced at the clock. It wasn't nine yet. How was he going to keep this green kid decently busy? Gus promptly made up his mind to sidestep the job.

Stan Hicks, relieved at last of the "boy's work" that had griped him so, was importantly busy over a valve-grinding job. Gus nodded toward him. "Any time you don't know what to do next," he said, "ask him."

"I did ask Mr. Hicks, and he . . . ."

"Go ahead," prompted Gus. "What did *Mister* Hicks say?"

"He told me to ask you."

"Buck passer!" From outside came the squawking of a horn. "Well, go out to the pump and see who's making that noise."

Greg hurried out. Joe Clark, coming in from the office to collect Saturday's time and parts slips, grinned at his partner. "How's the new boy doing?" he inquired.

"He's left-handed," Gus growled, "and he's got ten thumbs."

Joe laughed. "Give him a chance. The school people say he's a bright kid and a hard worker, and he did well in his mechanical-aptitude test."

Greg hurried back into the shop. "Hey, mister," he reported breathlessly, "there's a lady out there wants to buy five gallons of gas. What'll I do?"

"Sell it to her."

"Yeah—but I don't know how to work the—the—the *thing!*"

Gus groaned. Joe laughed again. "Come along. I'll show you how."

"Hey, mister," Greg said in a hoarse whisper. "I know why you can make the motor run and they can't."

Three minutes later Greg dashed back. "Hey, mister—the lady's car won't run! Mr. Clark wants you to come out."

Muttering under his breath, Gus followed him out to the pump, where the downstairs two-thirds of Joe's anatomy was protruding from a shiny coupe. A tall, thin woman stamped her foot angrily. "I'll register a complaint! A brand-new car to act like this! First my husband takes it on a business trip the day we get it. Then, the first time I get to drive it, this has to happen!"

"What seems to be the matter, ma'am?"

"I had five gallons of gasoline put in," she snapped, "and now it won't start!"

Joe ducked his head out. "Deader'n a doornail," he told Gus gloomily.

"Let me try it." Gus stepped into the car and pressed the starter button. The engine caught and purred sweetly.

"Well, I never!" shrilled the angry lady. Gus switched off the engine and got out. She flounced into the driver's seat. A minute of silence was terminated by her outraged voice: "It's just the same! It won't start!"

Joe smiled reassuringly. "Well, now, Mr. Wilson started it without the slightest difficulty, so—just let *me* try it."

She slid over, and Joe took her place. There was another short silence. Then Joe stuck his head out of the window. "She's dead, Gus," he reported.

Gus got in and again pressed the starter button. Again the engine took off promptly.

"Well, I *never!*" The customer thrust her jaw out. "If *you* can do it, there's no reason why *I* can't. Let me try again."

Gus got out, and she slid back behind the wheel. There was another silence. "It won't start!" she grated bitterly.

Everyone had forgotten about Greg. Now he twitched at the sleeve of Gus's coveralls and pulled him a little aside. "Hey, mister," he said in a hoarse whisper, "I know why you can make the motor run and they can't."

"You do, hey?" Gus said. "Why?"

"You push the thing up on top, and they stamp on the thing down on the bottom."

Gus stared at him. Then a grin spread over his face. "By gum," he said, "you've got more sense than any of the rest of us—which isn't saying much." He went over to the car and asked the woman to try to start its engine. This time he held the door open. She pawed with her left foot at the floor to the side of the clutch pedal, and then looked at him aggrievedly. "It's just the same," she said. "It's dead!"

Gus reached in to the instrument panel and pressed the starter button. At once the engine ran sweetly. "The trouble," he told her, "is that you've been trying to start your engine by stepping on your headlight-dimmer switch!"

The driver's long jaw sagged. But after a dejected moment the light of battle flared up in her eyes. "It's ridiculous!" she shrilled, "that all cars aren't arranged the same way. On my old car the starter was on the floor. Why did they have to stick it up there on the dashboard? There should be *uniformity!*"

She let in her clutch, and the coupe was off to a jack-rabbit start. Gus turned in time to see Joe disappearing through the office doorway. Even at that distance Gus saw that his partner's ears were a fiery red.

Greg again pulled at his sleeve. "Hey, mister," he asked, "what'll I do now?"

Gus fished a dollar bill out of his pocket. "You know that cigar store near the station?" he asked. "Well, get me a half-pound can of 'Delight' tobacco."

Greg hurried off, and Gus went back to his shop. "It'll take him half an hour to walk down there and back," he thought, "and I'll have a little peace for that long."

GUS was wrong about that. He hadn't got well restarted on his job when he heard the harsh scream of jammed-on brakes.

Stan Hicks hurried over to the shop door. "A guy in a sedan nearly ran up a truck's tail," he reported. "I don't think he hit it, but there's something the matter—he and the truck driver are having a row."

Gus grunted disinterestedly. Stan continued to observe the ruckus out on the street. "Say, boss," he said after a few minutes, "that guy's back in his car, and he's drivin' it in here."

"He's all yours, *Mister* Hicks," Gus told him. He got a worm's-eye view of a red-faced man with a bristling black mustache hopping out of a sedan with a steaming radiator.

"Huh," Stan remarked, "so you *did* hit that truck. I thought you just missed it."

"I did *not* hit it!" roared the sedan's owner. "And no thanks to its driver. I'll have the law on his firm if they don't pay for the damage, sure as my name's Gunzenhouser! Stopping smack in front of me, and no stoplight or signal!"

"That's bad," Stan said sympathetically. "But if you didn't bump the truck, what busted the radiator?"

Gus didn't hear much of Mr. Gunzenhouser's heated and lengthy reply—he was distracted by a rustling sound near his feet, and on looking down saw Greg crawling toward him with a package in his hand. "Here's your tobacco, mister," he panted.

"Thanks," Gus said disgustedly. "How'd you get back so quick—take a plane?"

"I thumbed a ride both ways," Greg explained. "What'll I do now, mister?"

"Go tell Mr. Clark I said for you to help him in the stockroom."

Greg crawled away, but after a few minutes Stan came over to Gus. "You'll have to help me on this one, boss," he admitted. "I can fix the guy's radiator, but I can't find out what busted it. There's not a mark on it *outside*."

"Oh, all right," Gus said, and went over to the sedan. He examined the inner side of its radiator, and found it badly gashed. It looked to him as if the damage had been done by the fan, but careful checking showed that there was adequate clearance between the fan blades and the radiator, that the blades were tight, and that there was no end play in the fan shaft.

Gus scratched his ear and whistled tunelessly between his teeth. After half a minute he turned to Gunzenhouser. "You say you didn't hit that truck?" he asked.

"Didn't touch it. Take my word for it."

"I do. Well, now—ever had any trouble with your radiator hoses leaking?"

"I certainly have!" Gunzenhouser snapped. "They've been a nuisance for the last couple of months. I tightened 'em a couple of times and that didn't do it. I even took 'em off and put on gasket cement."

Gus nodded. "Does your throttle stick or fly open on turns?"

"What are you—a mind reader? Yes—my throttle often sticks when I make a turn at fair speed."

"One thing more," Gus said. "Have any starting trouble?"

"I've had a little," Gunzenhouser replied. "Now suppose *you* answer a question. What's the matter with my car?"

"Broken or worn-out engine supports," Gus told him. "When certain types of rubber engine mounts get old they soften up or separate from their metal brackets and allow the engine to settle or get out of line. The radiator hose tries to hold it upright, but of course it can't, and the strain opens leaks. On turns, the drag of the engine on the throttle linkage makes the throttle either stick or fly wide open. Hard starting is caused by the bad mounts allowing the rear of the engine to set so low that the kick throttle can't release the automatic choke when the starter is operated. Your mounts are so far gone that when you made a sudden stop, the engine shifted forward and drove the fan blades into the radiator. . . . New engine mounts—that's the only answer."

"You're the doctor," Gunzenhouser said. "Put 'em in, and fix the radiator. I'll be in for the car tomorrow. Okay?"

"Okay," Gus agreed. He returned to the Knowles job. "Now," he growled, "I hope I'll have a chance to do some of *my* work!" Then he felt a hand on his arm.

"Mr. Clark's through with me," Greg said. "What'll I do now, mister?" END

Adding Vacuum Brakes to a Trailer

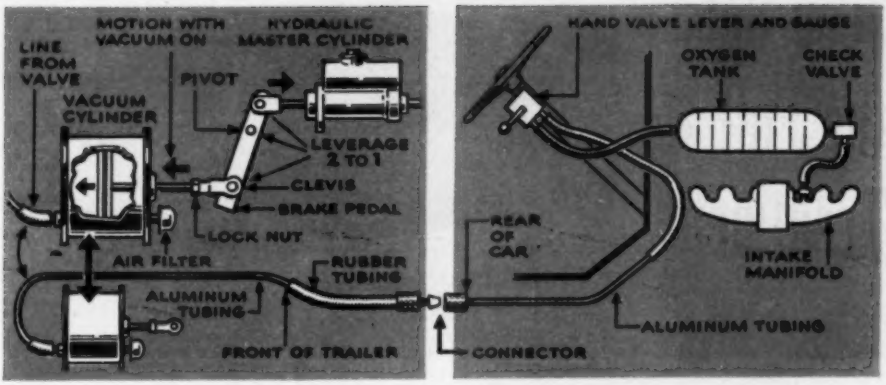
Hydraulic brakes on this trailer are operated from the car. A hand valve (inset) actuates a vacuum cylinder linked to the hydraulic master cylinder. A gauge shows the vacuum being used.

STRIPPED down to serve as a trailer, the old auto chassis above still has its hydraulic brakes but they're now applied by vacuum instead of by foot pressure. The intake manifold of the towing car provides the vacuum. A vacuum-line connector designed for trailer trucks allows quick coupling or uncoupling of the trailer.

Nearly all the parts required were obtained from a truck-supply company. No

Reserve vacuum for faster brake action comes from this booster tank. There's a check valve in the vacuum line from the intake manifold.

A connector designed for trucks couples the vacuum lines, and a plug makes the electrical connection. Most states require safety chains.



changes were made in the chassis aside from installation of a towing and steering mechanism and addition of two extra leaves to each spring. A drop center in the trailer floor lowers the center of gravity. If desired, a house trailer could be placed on this chassis, or the brake system adapted to a two-wheel house trailer.

The trailer brakes are operated with a hand valve clamped to the steering column of the car. This valve includes a gauge to indicate the vacuum being applied. A booster tank with a check valve provides reserve vacuum. This was originally an oxygen tank, obtained from a war-surplus outlet. A T-fitting, substituted for the wiper fitting on the manifold, permits attachment of both the wiper and brake lines.

Two ¾" holes were drilled in the instrument panel, one for the line from the manifold to the hand valve and another for the line to the trailer. Most of the line is ½" aluminum tubing, but thick-walled rubber tubing was used at some points for flexibility.

The vacuum cylinder used in this installation has identical outlets at each end to give either a pulling or pushing action. About 8" in diameter, the cylinder has a 5½" stroke. Only a small part of the stroke is employed, however, when the brakes are properly adjusted.

In this case, it was found possible to retain the brake pedal as the linkage between the hydraulic and vacuum cylinders. Swung downward to provide clearance for the trailer floor, the pedal was pivoted for a two-to-one leverage. Its lower end was drilled for connection to the vacuum-cylinder piston. With the position of the pedal reversed, the cylinder pulls to apply the brakes.

Except on trailers of welded construction, a two-wire electrical circuit to the tail, clearance, and stop lights probably will do the best job. The hot side can be taken off the car taillight and the other side grounded. On the trailer, hook up the stop light through the master-cylinder switch so it will operate when the brakes are applied.

A little practice will show how much vacuum is needed to apply the brakes evenly. Smoothest action is obtained by pulling the hand valve a short distance, releasing it, and then pulling again. Full vacuum will usually slide the wheels. When parking with the engine shut off, it's probably wise not to count on the trailer brakes, though this one has held full vacuum for as long as 45 min.—*Charles T. Pearson, Chicago.*

Simple Light Checks Timing

Here's a simple timing light that will help you check and adjust the setting of distributor points. It also serves as a handy trouble light.

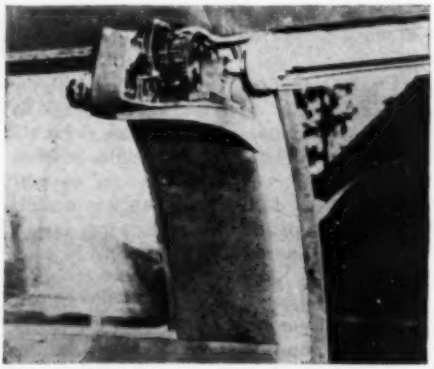
It was made by soldering the socket of a single-contact parking-light bulb to the pivoting end of a storage battery clip. One end of a 6' length of insulated wire was then attached to the socket and the other to a small battery clip. It may be used for timing by attaching the small clip to the low-voltage distributor terminal and clipping the bulb in a place where it will illuminate the flywheel timing mark as it flashes on. This will enable you to rotate the distributor body as required.—*John M. Avery, Delhi, N. Y.*

Jeep Gets the Full Treatment

A special body was fabricated from sheet steel. The doors are power operated, and the curved windows are clear plastic.

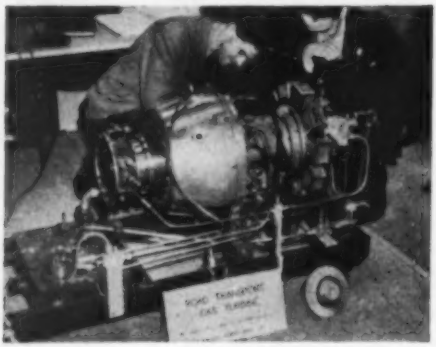
SOME surprising changes can take place when imaginative mechanics get hold of a Jeep ⓣ. This one is the off-duty work of two members of the U. S. Air Force stationed in Japan. Buying a Jeep for $335, they discarded the old body and planed down the cylinder head to boost compression. Then they drew up specifications for a striking new body and engaged a Japanese bus factory to build it. Among the many features are power-operated doors and leather-upholstered seats that fold to make a bed. When complete, the job had cost less than $1,000, including about $400 for the body.

The driver's armrest swings down out of the way to allow unobstructed entrance and exit.



This mechanism operates the doors. The housing has been removed here to show it more clearly.

British Test Gas Turbine as Auto Power Plant



DESIGNED especially for use in passenger vehicles, this gas turbine is now undergoing tests in England.

Adapted from aircraft gas turbines, it weighs only 300 lb., develops 160 hp., and burns almost any oil as fuel. The British designers have given no hint, however, whether it overcomes two problems encountered by other experimenters—objectionable exhaust blast and excessive fuel consumption (PS, Nov. '47, p. 128). It has an electric starter and a glow plug for starting ignition. Power is delivered to a hydraulic coupling that operates at 17,000 to 35,000 r.p.m.

Mechanics and Handicraft

Abrasive Wheel Slices Steel PAGE 188

Spray On a Velvet Coating PAGE 160

What's New in Jet Models? PAGE 164

Building Your Own Enlarger PAGE 195

Give Blind Radios a Tuning Eye PAGE 201

Spare the hacksaw, save the muscle. Motor-driven cut-off wheel saws anything. Page 188.

Map Measurer Rolls Off the Miles

To use measurer, push it over the map on the route selected. Rolling wheel clocks distance.

ROLLED along a map to follow curved highways or irregular small-boat courses, this measurer gives you the distance in inches that it's moved. Changing inches to miles is then just a quick calculation with the inch scale on the map. You could, of course, calibrate the gadget to read distance directly, on maps of the same scale. For accuracy, take three readings and average them.

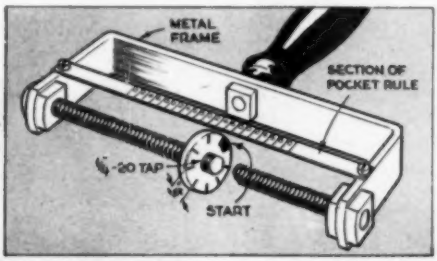
As you see here, the measurer is strictly a kitchen-table project, made without recourse to a lathe or other power tools. A few hand tools are all you'll need. Also, it can be put together in one evening. The frame is from a 4" print roller costing 35 cents; the shaft is a machine screw; the roller, a common fiber washer.

Hacksaw off the rubber roller and replace it with a ¼"-20 screw about 4¼" long, held by three nuts. File down the frame ends and nuts to give maximum clearance. Find a hard fiber washer around 11/16" in diameter, and check to find the exact distance it rolls in one revolution. (Mine rolled a precise 2¼".) Drill it 7/32" and turn it onto a ¼"-20 screw, which will serve as a tap.

Mark off a paper scale that shows the number of turns the wheel makes; one that has an index line for each two revolutions (1/10" for a 20 t.p.i. screw) will be satisfactory. Use transparent tape to attach the scale to a thin steel pocket rule, and screw it to the frame near the wheel. Mark a center line on the edge of the wheel, and mark the side of the wheel with a starting point and divisions equivalent to ¼" travel, so distances can be read to less than one revolution.—*Arthur Miller, Manhattan, N. Y.*

Remove the rubber squeegee from the frame by sawing through the metal shaft. Use a file to round off the corners of the nuts. Before tapping the center of the washer, run a 7/32" drill through. The fiber washer can be tapped with a ¼"-20 machine screw, as in the photo at right.

Ink a black line all around the fiber wheel in the center of the edge. Paint the sides white.



This drawing gives you construction details of the measurer. The scale is taped to a small rule.

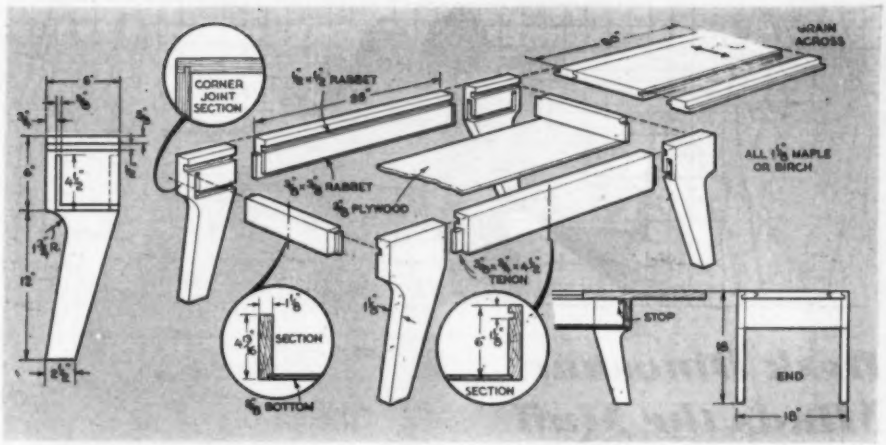


Table Has Sliding Top

Sliding top doubles the size of this maple or birch table.

THE most important consideration in building this sliding-top coffee table is exactness. Accurate cutting and fitting are musts.

In the currently popular light maple or birch, this piece is an asset to any room. Sugar, cream, and sandwiches may be served from the compartment with cups and saucers on the extended leaves. The table nicely holds snack servings for six persons.

For the best appearance, 1⅛" stock is recommended, although a lighter wood may be used. Construction is pretty much a rabbeting and mortise-and-tenon job, with all joints glued. Shape the legs first, cutting the mortises and then joining them to the side members. After that, rabbet the slots in each unit for the sliding leaves. After gluing the joints, be sure to remove any excess that squeezes out. Otherwise, the finish will be spotty.

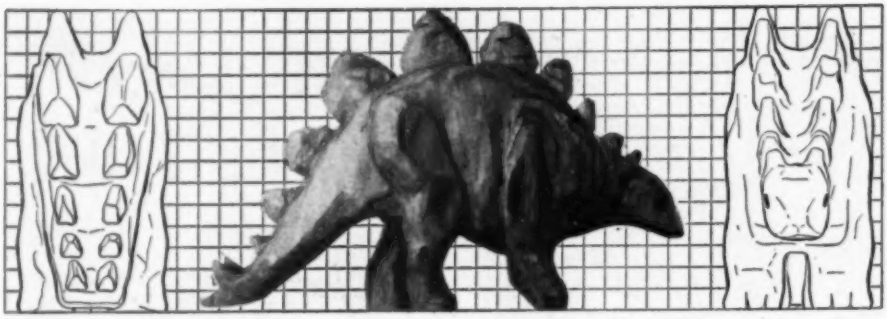
With the two side frames completed, join them with the cross members by mortise and tenon, as shown in the drawing. Sand the slots for the sliding top until they are smooth. Then apply wax.

Each leaf is made up of three pieces, the middle piece with the grain crosswise and the side pieces with the grain lengthwise. Assembly is by tongue and groove. The lips that run in the slots should not be actually tight, and yet not too loose. Sand the lips carefully until they are smooth and allow at least 1/32" clearance between the lips and the slots so the parts will not bind.

Cut finger grips in the top end of each leaf and peg a dowel on the underside of each one as a stop. For the bottom, use ⅜" plywood and fasten it in place with glue and screws. You'll need about two dozen 1" No. 7 flathead wood screws. A shellac and wax finish will give the table a high, rich polish.—*Hi Sibley, Nuevo, Calif.*

Rubber Door Stop Used As Pipe Rack

A RUBBER doorstop, which can be purchased for about a dime, makes a handy rack for a pipe, as shown at the right. The stop may be used alone as a pipe rest, or it and an ash tray may be screwed to a wooden base.—*H. Klein, Pittsburgh, Pa.*



Desk Dinosaur Minds the Mail

Either Bevel the top edge of the base or use a shaper cutter to give it a decorative finish.

HERE's another prehistoric horror, scaled down to a safe 3½" and mounted to decorate a letter rack.

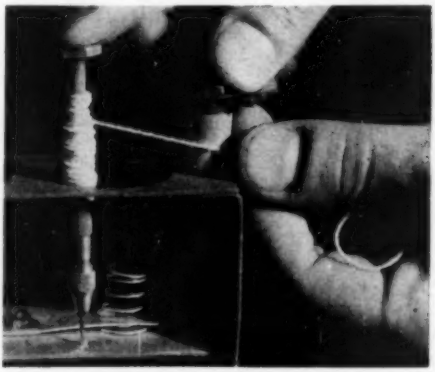
This big lizard—a stegosaurus—was an early dinosaur. He exceeded a modern elephant in bulk. To give you an idea of his size, the largest of the spiny fins on his back was 3' high.

Lay out the pattern on 2" stock by tracing it on a grid of ¼" squares. I used redwood but this breaks easily when carved into small projections such as the fins. You may prefer pine or basswood. Do the carving with a knife and carving chisels. Motor-driven burrs are helpful in cleaning out the surplus material between the fins and between the legs. However, you can do the job with just a knife.

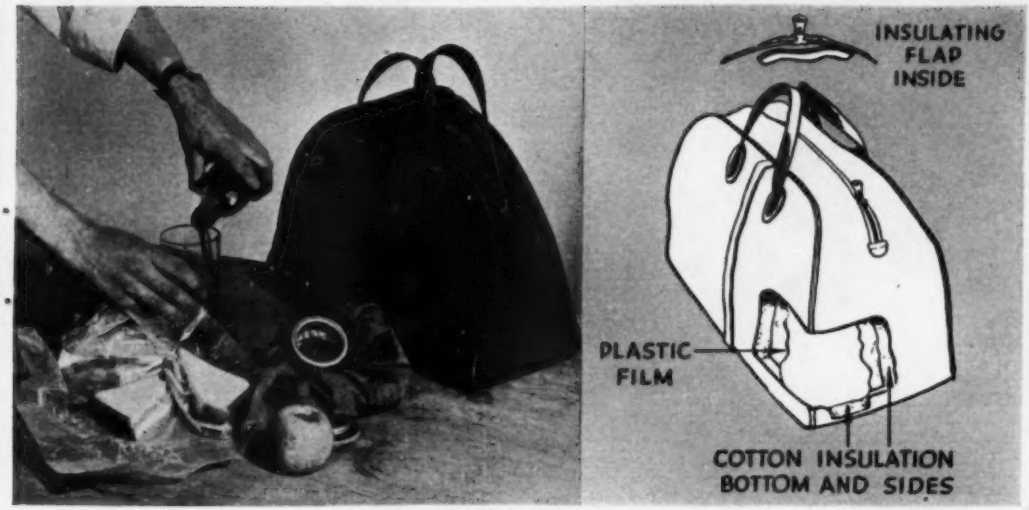
Sand the figure well but do not destroy the carved planes. Put on the eyes, nostrils, and mouth with India ink and a pen. Redwood needs only a coat of shellac. Other kinds of wood may be stained or painted.

The base is 5" by 7" hardwood ¾" thick. Bevel the top edges. At 1" and 2½" from the rear edge, cut blind dadoes ⅛" wide and ¼" deep for two clear plastic sheets. These are ⅛" by 3½" by 5½". Cement them in place and mount the figure with glue and small screws.—*Elma Waltner, Hurley, S. D.*

Pin Vise and String Drill Holes in Tight Quarters



NEXT time you want to drill a hole in a spot where there is barely enough room to move a hand, try winding a few feet of stout string around a pin vise. You'll also need a pad or button with a short shank to fit loosely into the hollow vise body. Apply pressure on the button as shown and pull the string. The efficiency of this dodge will surprise you. I've used it to drill through 1/16" thick brass with one pull of a 3' length of cord. Light fishing line will do fine.—*Herbert Pfister, Bronx, N. Y.*



This homemade beach-bag "icebox" will keep drinks cool, food fresh for as long as 16 hours.

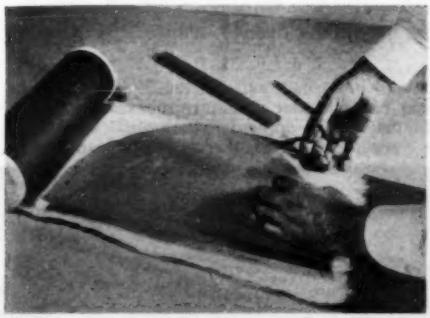
Picnic Bag Keeps Food Cold

HERE'S what you need to make this lightweight, picnic refrigerator: A canvas beach bag, an ice bag, a pound roll of nonsterile cotton, and a plastic-film tablecloth cover.

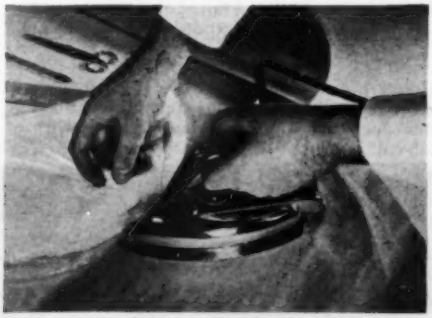
Make paper patterns of the end, side, and bottom of the beach bag, cutting them about 1" larger all around. Cut enough cotton for three layers on each side and on the bottom. Then cut two pieces of plastic for each side, end, and bottom.

Put three layers of cotton between each two pieces of plastic. Seal the edges of the plastic with an iron, pressing through a sheet of paper. Don't have the iron too hot, or the plastic may disintegrate. Stitch the insulating pieces in the bag. Finally, make an insulating strip to fit just beneath the zipper.

A tray of ice cubes in the ice bag will do for most purposes, though you can also use dry ice (solid carbon dioxide). But put it in a can that has holes punched in it; don't put dry ice in an ice bag and screw the cap on, since the gas released would rupture anything watertight. Use the bag also when shopping for frozen food.—*F. Tobin, Chicago.*



Make paper patterns of the sides and bottom of the bag. Then cut the cotton and plastic to fit.



When sealing the plastic sheets with an iron, cover the plastic with a piece of heavy paper.

Flock comes in many colors. It's made of fine rayon fibers, cut to length and then dyed. You have a choice of two lengths—1/32" and 1/16". Two colors may be mixed for an intermediate hue. For example, the pale blue above was made by mixing a quantity of white and dark blue.

Paint It with Rayon

With dyed flock, you can give any surface a colorful, velvety finish.

PHONOGRAPH turntables aren't naturally fur-bearing. That velvetlike surface on them is a finish called flock. It consists of tiny bits of fiber—some 250,000 to a square inch—standing on end in a coating of adhesive.

Flock finishing is now within the reach of any craftsman. Kits are available containing everything needed—a special spray gun,

Here's how it's done. Because the cabinet had been damaged and rather poorly repaired, it was decided to apply flock. Cleaning with a solvent was the first step. (Porous surfaces should be sealed with shellac.) Then a thin coat of undercoat adhesive, the same color as the flock, was applied evenly and allowed to become tacky. Next, flock was put in the gun.

A flock lining does the job of velvet in this jewel box. Outside, it's just for decoration. On the carving, it adds lifelike texture.

A crack in the plaster base of this lamp was still conspicuous after being cemented. Flock hid it. The shade decorations are also flock.

adhesive undercoat, thinner for the latter, and a supply of flock in various colors.

To use it, you first brush on a thin coating of the adhesive. Like the flock, this undercoat comes in different colors. Unless you want an unusual effect, the two colors should be matched. When the adhesive is tacky, the flock is sprayed on.

You can apply flock as padding under such projects as ash trays or book ends, and as a lining in a jewel box. If you make model furniture, flock would enable you to "upholster" each piece. Similarly, it could be used as "fur" on toy or model animals.

If you wish, the material may be used as pure decoration. The lamp shade above is an example. Here the pattern was painted with undercoater and the flock then sprayed on. Novelty greeting cards are another possibility with this technique.

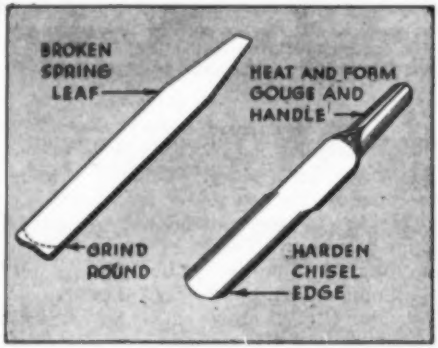
Flock was sprayed on vigorously from 4" to 6" away. Ordinarily, the gun should be at right angles to the surface. (Below, it was tilted to blow flock into the louvers.) Overspray is caught by placing the work in an open carton. This can then be gathered up and reused. After the coating has dried 10 to 15 hours, remove loose flock with a very soft brush.

4

5

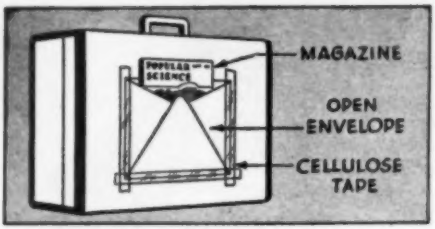
Ball-Point Pen Makes Stylus

An empty ball pen or cartridge—the type with the ball built in—is worth keeping as a smooth-acting, round-point stylus. Craftsmen can emboss leather or metal foil with it, as above. It's also fine for drawing on duplicating stencils. Used with carbon paper, it makes dark, clear copies without smudging the original lines as a pencil will.



Big Chisel Forged from Spring

A keen, durable chisel, especially good for tree surgery, may be made from a broken auto spring leaf. Grind the broken end to the desired shape. Then in a forge or furnace soften the metal for blacksmithing into a gouge contour. At the other end of the spring section, roll the edges together to form a suitable shank for hammering. Before rehardening, rough-grind the chisel edge. Hone it sharp after hardening. Leave the rolled end soft.—*E. F. Lindsley, North Prairie, Wis.*



Envelope Holds Magazines

Did you ever hesitate to buy a magazine as you rushed for a train because you already had your hands full with bags and a coat? A large Manila envelope, taped to the side of your bag, makes a fine emergency carrier for a book or magazine. You can buy the envelope in any stationery store. Simply tear off the flap and use cellulose tape to hold it to the side of the bag.—*Rudolph Malkin, Syracuse, N. Y.*

Cord Has Soft Rubber Plugs

An extension cord set with an unbreakable, three-way plug and attachment plug of soft rubber has been announced by the United States Rubber Company. Intended for general household use, the set is produced in lengths of 6′, 9′, and 15′ of No. 18 rubber-insulated wire.

Worm Holes Produced by Burr

Worm holes add an authentic air to antique copies. A discarded dentist's burr, in a chuck turning at 3,500 r.p.m. or faster, will produce realistic ones. Vary depth and direction as shown.—*Reginald O. Lissaman, Brandon, Man.*

Typing Table Has Built-in Wastebasket

Two things that go together like ham and eggs are a typewriter and a wastebasket. Whether you're a professional writer or whether you just use your typewriter for occasional correspondence, you'll still need a wastebasket nearby.

The combination pictured above is another practical solution devised by the Editor for his own use. The typing stand is lightweight, yet steady. It slides easily over floors or carpeting, although there are no casters on it. Instead, there is a glider in each lower corner. The compact unit is small enough to be slipped into a closet or little-used corner for storage.

The top, butted against the back and the two sides, was dimensioned for one of the smaller portable typewriters. It may have to be bigger to fit yours. Butt joints were used throughout, and the pieces—all ¾" pine—were assembled with No. 8 1¼" wood screws and glue. Sand the wood smooth and finish it to harmonize with the color scheme of the room where it will be used.

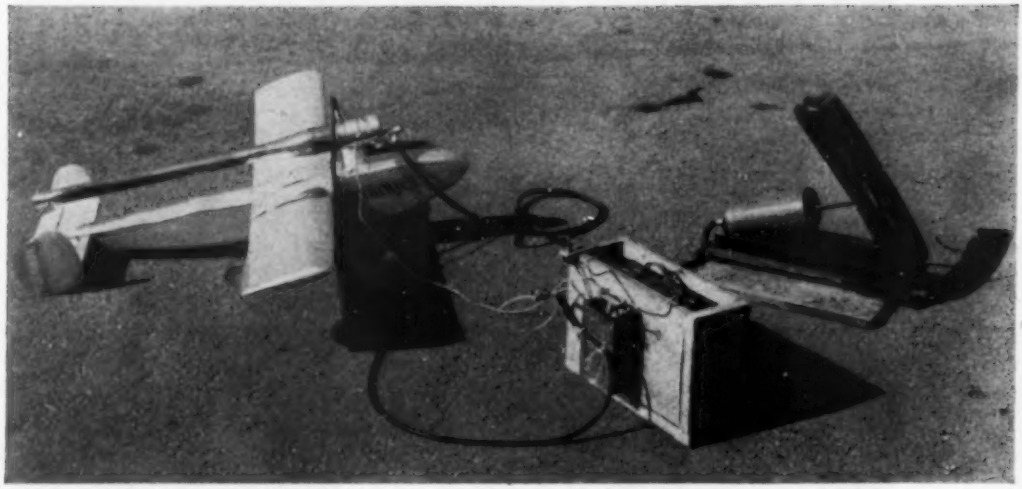
Thumb Indexing Phone Book with Engraving Tool

With an electric engraving tool of the vibrator type you can thumb-index phone books, catalogs, and other volumes.

Decide how many notches are required. Then measure the long edge and divide it for the needed number. Cut the notches in the pages preceding each letter. For instance, turn to the start of the A's. Lay a piece of thin wood on that page, turn back the preceding pages, and cut the notch.

To index with two rows of notches, one facing left and the other right from the center of a book: Cut the left-hand notches in pages following the letters and the right-hand notches in pages preceding the letters. An unabridged dictionary is a good model.

Use a wood-carving bit or a half-round gouge. Hold it at a 25-deg. angle for the initial cut, more upright in finishing the notch.



Starting setup for a jet model includes pump at right for compressed air and Ford coil for continuous, high-tension current to spark plug. Lines are removed after jet has been started.

Model Jet Planes Top 140 m.p.h.

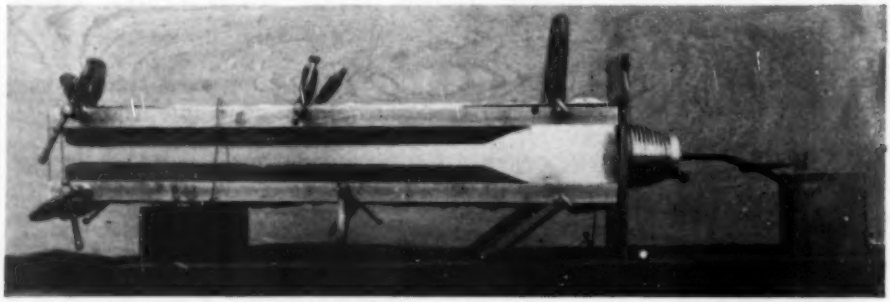
Pulse jets find increased favor with modelers as experimenters work bugs out of war-developed power plants.

By J. H. Lemelson and R. F. Probstein

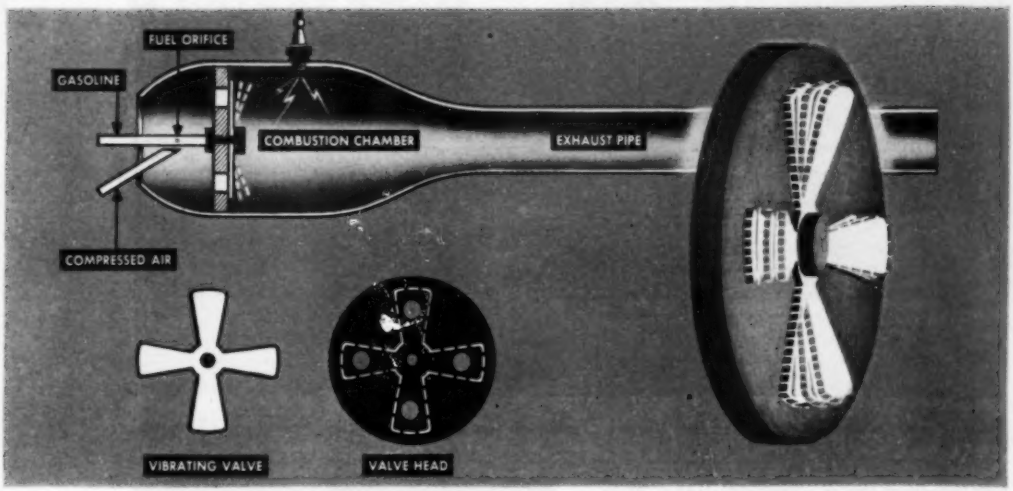
MODEL builders are switching to jets. In increasing numbers, enthusiasts are fitting miniature planes, boats, and racing cars with small jet engines—the same type that powered the Nazi buzz bombs.

These little power plants measure less than 2′ long and are from 2″ to 3″ in diameter. They weigh about a pound and develop more than 4 lb. of thrust, enough to whiz a model plane along at speeds well over 100 m.p.h. In fact, the Academy of Model Aeronautics officially clocked one at 141.07 m.p.h.

This type of engine is known as the pulse jet or intermittent jet. It also has been



High-speed cameras record explosion characteristics of this glass-walled jet at New York University School of Engineering. Model has short life since heat cracks walls after 30 seconds.



Parts of a pulse-jet engine are shown here. As each explosion blasts gas from exhaust pipe, valve is sucked open to admit air and fuel for following explosion. Valve is sole moving part.

tagged with such names as buzz jet, resojet, and aeroresonator. The principle on which it works is fairly simple. Air is ducted through the inlet valve to the combustion chamber. An elementary carburetor vaporizes the fuel. The only moving part is a petal-type valve that opens and closes with each explosion. Combustion chamber and exhaust pipe are heat-resistant steel, about .015″ thick.

Compressed air and a spark plug are used for starting. After the engine begins to fire, combustion is self-sustaining and the lines to the air vent and plug are disconnected. Thrust is created by a series of rapid explosions, about 250 per second. The result is a steady push. In contrast, the turbojet and rocket develop thrust by a continuous flow of combustion gases.

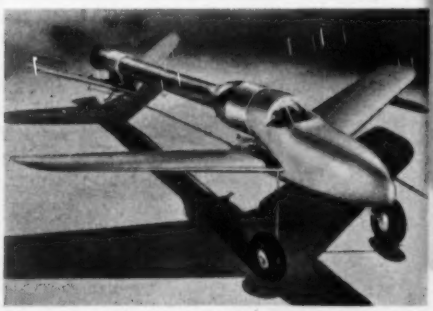
For power comparison, a model gas engine developing 1 hp. at 100 m.p.h. with 75 percent prop efficiency exerts about 2.8 lb. of thrust. A small jet engine at the same speed exerts around 4 lb. of thrust.

Model jet planes are flown in a circle at the end of 60′ to 70′ control wires. The planes, with wingspreads up to 4′, carry 4 to 7 oz. of nonleaded gasoline, enough for 30 to 40 laps.

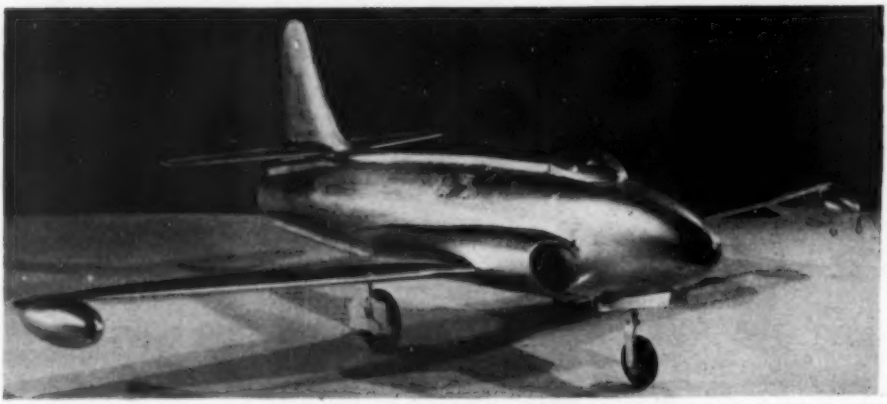
Besides planes, other jet-driven models include boats, automobiles, and iceboats. One of the latter was timed at 129 m.p.h. and a car at 125 m.p.h.

A few modelers began using jets shortly after the war. The first models were both troublesome to start and to keep running. Improvements since then have provided a fairly reliable engine. One manufacturer of

Model of Bell XS-1 experimental plane with jet mounted inside fuselage. Dolly is for take-off.



Engine built as rear of fuselage with exhaust pipe as tail boom. Elevator rod is below tube.

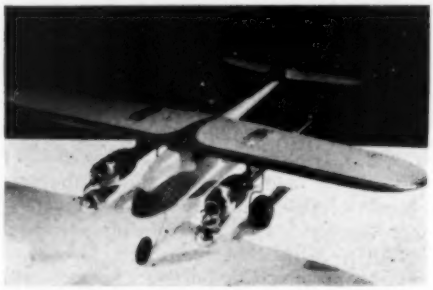


Engine is mounted internally in this model. Tanks on wings are dummies. Speed is 112 m.p.h.

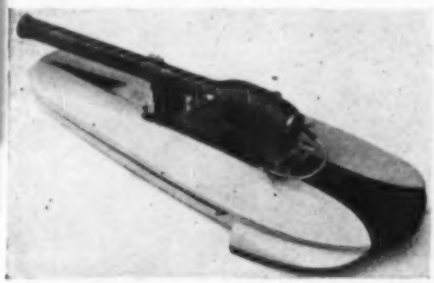
kits claims a finely perfected fuel system—so finely perfected that the jet engine may be stopped and started while in flight. The manufacturer says the engine is stopped by pulling the model up into a stall. At a speed above 90 m.p.h., the engine will start again when the model is returned to level flight. The stall disturbs the air flow into the combustion chamber. Level flight forces fuel and air into the chamber, where the heat restarts combustion.

Four persons usually make up the starting team for a model jet. One man holds the model, keeping his hands well away from the tailpipe and combustion chamber. As the engine begins to fire these parts heat up to a bright red. However, once the model is in motion, the flow of air cools the engine. A second man handles the ignition; a third the compressed air; and the fourth acts as pilot, holding the control wires. Starting is characterized by a low purr that soon mounts to a loud roar.

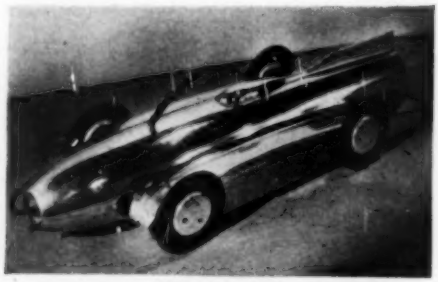
Crashes occur occasionally. When they do, the model usually is smashed beyond repair. Sometimes the engine, which sells for about $35, is salvageable. At a recent meet, one of the jet planes crashed a heavy, fine-mesh wire fence. The balsa wings and fuselage were shredded to snowflake-like bits as the model rammed through the fence. The engine, badly damaged, remained on the other side of the fence. END



A twin-engined job with gas tanks slung under each jet engine. Fuselage and wings are balsa.



Jet power is being adapted to speedboats, too. This model now is undergoing performance tests.



This jet racer is of cast aluminum, 22½" long. Car runs on tracks, topped 125 m.p.h. in test.

Whatnot Shelf Lighted from Below

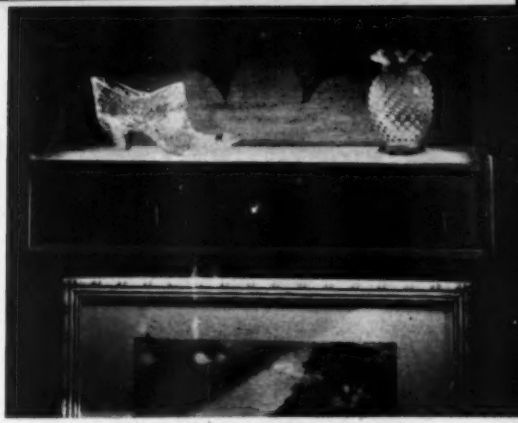
KNICKKNACKS, especially glass objects, are displayed effectively on this fluorescent-lighted shelf.

The dimensions in the drawing are for a 14-watt lamp. However, by simply increasing the length, a 15- or 20-watt lamp may be used. The stock is ¾" white pine.

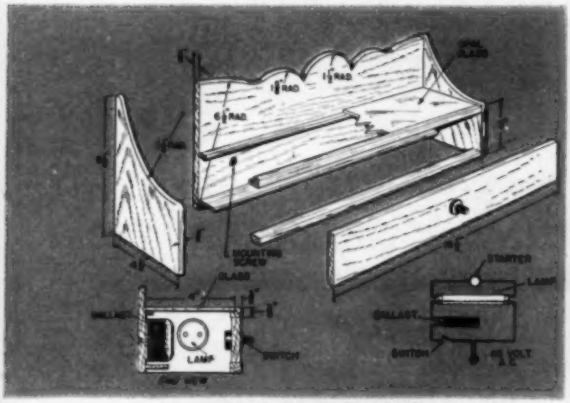
The top of the shelf is a 4" strip of single-weight window glass, ground on one side to diffuse the light. Lay the glass on a newspaper. Sprinkle on it about ½ teaspoon of abrasive powder such as No. 120 silicon carbide. Add a little water. Rub this mixture with a fragment of grinding wheel held flat, or with another piece of glass. Use a circular motion. In a few minutes you'll have a frosted surface on the glass.

Fasten the wooden parts together with glue and brads. Set the nail heads deeply and fill the holes with composition wood. The front panel, which resembles a drawer, is made by assembling three pieces of wood as shown, or by framing a single piece.

Mount the ballast unit on the back panel just below the glass. The sockets go on the back panel also, as shown in a photograph. Give the completed shelf a coat of antique maple stain, followed by shellac and wax.—*Walter E. Burton, Akron, O.*



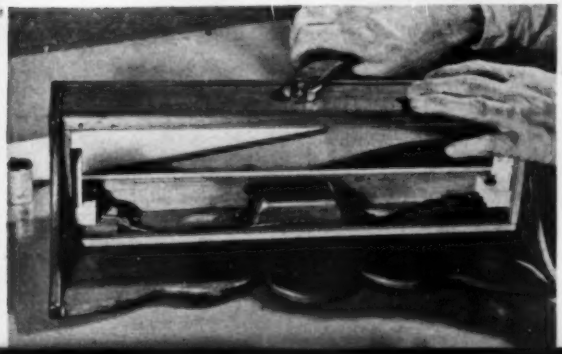
Aglow with light above and below, the shelf is a focal point of interest in a room at night.



Back panel of the shelf is laid out with compass curves that are faired together freehand.

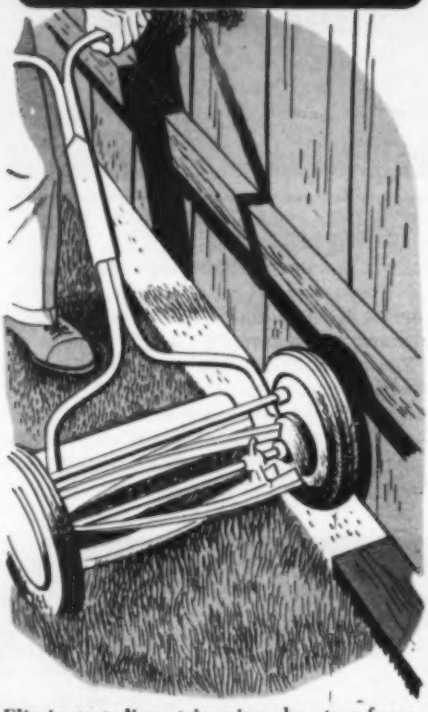
Round the edges with a knife or other tool and then sand smooth with an abrasive-cloth strip.

Ballast and sockets are mounted on the back. Center-mounted switch resembles a drawer pull.



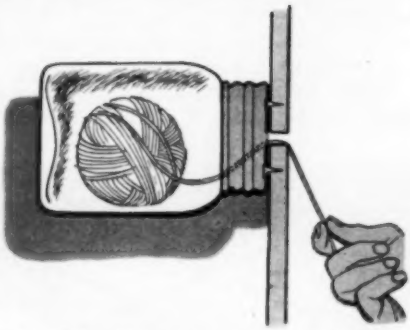
You can make ground glass if need be. Use abrasive grains, water, an old abrasive wheel.

Keeping the Home Shipshape

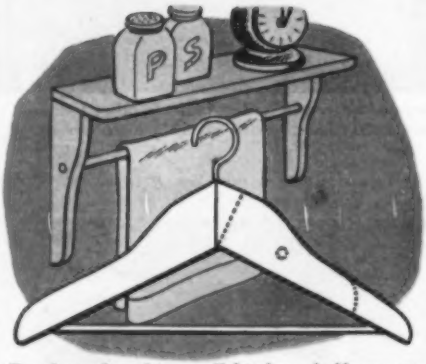


Eliminate tedious trimming close to a fence by keeping long, narrow boards under it to stop the growth of grass there. Replace them after using the lawn mower.

When lifting stoves, metal cabinets, or other heavy objects that may have sharp edges, pieces of old garden hose will protect your hands. Slit the hose sections and slip them on.



With this holder, you won't have to look for the ball of twine when you need it. Bore a ¼" hole in a shelf support or cupboard wall. Two screws will hold on the jar top.

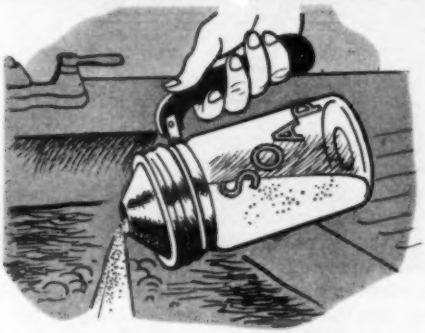


Brackets for this small kitchen shelf are cut from a single wooden coat hanger. The top is a piece of ¾" plywood. Drill holes for screws and for the dowel and finish with enamel.

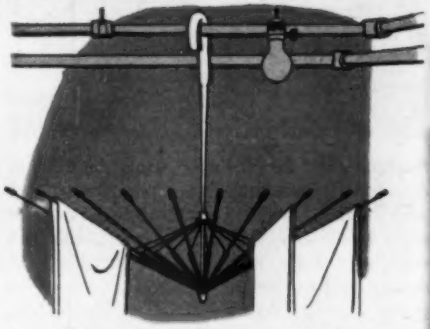
Two baking pans hinged together along one side provide a fine steamer for a few ears of sweet corn. Fasten a knob on an upper edge of one pan, and don't use too much water.

If your toaster gets away from you, try salvaging the remains with an ordinary grater. Hold the grater under the toast so the burned crumbs won't fall back on the slice.

A small cork makes a handy work-bag carrier for a thimble and a scissors. The thimble is easier to find and your fingers are protected against injury by the scissors' points.



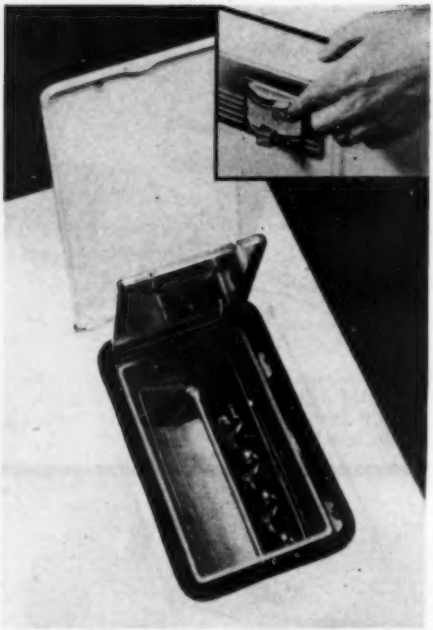
A kitchen dispenser for powdered soap can be made from a fruit jar, a metal strap, and a coffee-maker handle. Cut the top off a beer can for the dispenser's top. Letter the jar.



An old umbrella makes a good rack for drying clothes in crowded quarters indoors. Strip off the fabric, open the umbrella, and hang it by the handle. It stows away in a small space.

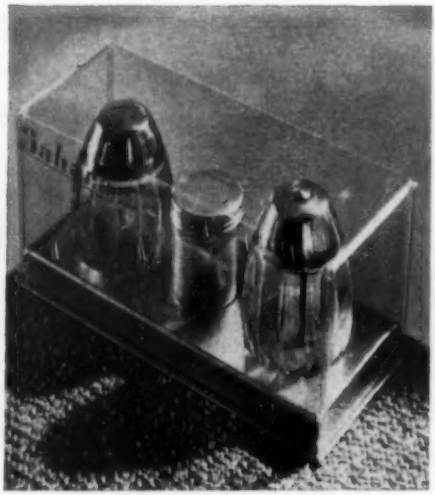
Clothespins can be kept conveniently at hand in a box that rides along the line on small pulleys. Drill several holes in the bottom of the box so that rainwater won't collect inside.

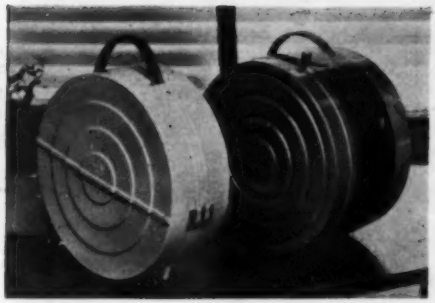
Squeezer Is Mixer Too. The Juice-A-Shake ⓣ combines squeezing, straining, and shaking in one compact unit. It may be used to make orange juice, milk shakes, or cocktails. Eggs also may be prepared for scrambling or cream whipped in the three-piece plastic juicer. It is available in four color combinations and is offered by the Kerel Products Company, Bronx, N. Y., at a retail price of $5.



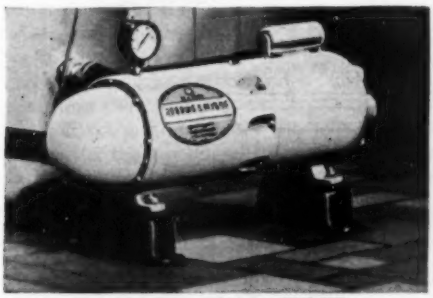
Soap Automatically Injected. With some new models of Bendix washers, a housewife merely loads it with soap powder, detergent, or water softener, sets the timer, and forgets about it. At the correct moment in the washing cycle, the powder is fed into the tub by the screw visible in the bottom of the compartment. The agitator, a rotating wire reel, sends a constant supply of soap to the feeder screw.

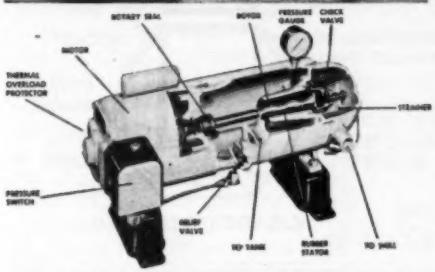
Keeps Salt Dry. In damp weather, you don't have to bang this shaker on the table to get salt out. A drying unit, shown in the drawing, contains silica gel—a highly absorbent substance. After several weeks use, the gel gradually changes color from blue to pink as it absorbs moisture. The unit is reactivated by putting it in a moderately hot oven. Meanwhile, a spare drying unit may be used. The saltcellar, with matching pepper container, is made by J. H. Young Co., Pittsburgh, to sell for about $6.50.



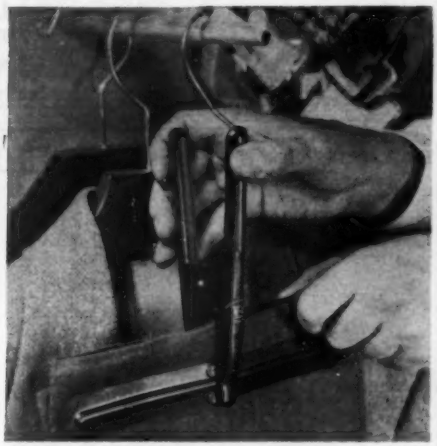


Top Becomes Turntable. This matched plastic pair—a portable electric record player and a carrying case for 25 10″ records—is made by the Anfinsen Plastic Molding Co., of Aurora, Ill. The top of the 7-lb. player is the turntable when inverted. Ten records may be stored in the bottom of the player. Both pieces are available in several colors and both are provided with elastic carrying straps.



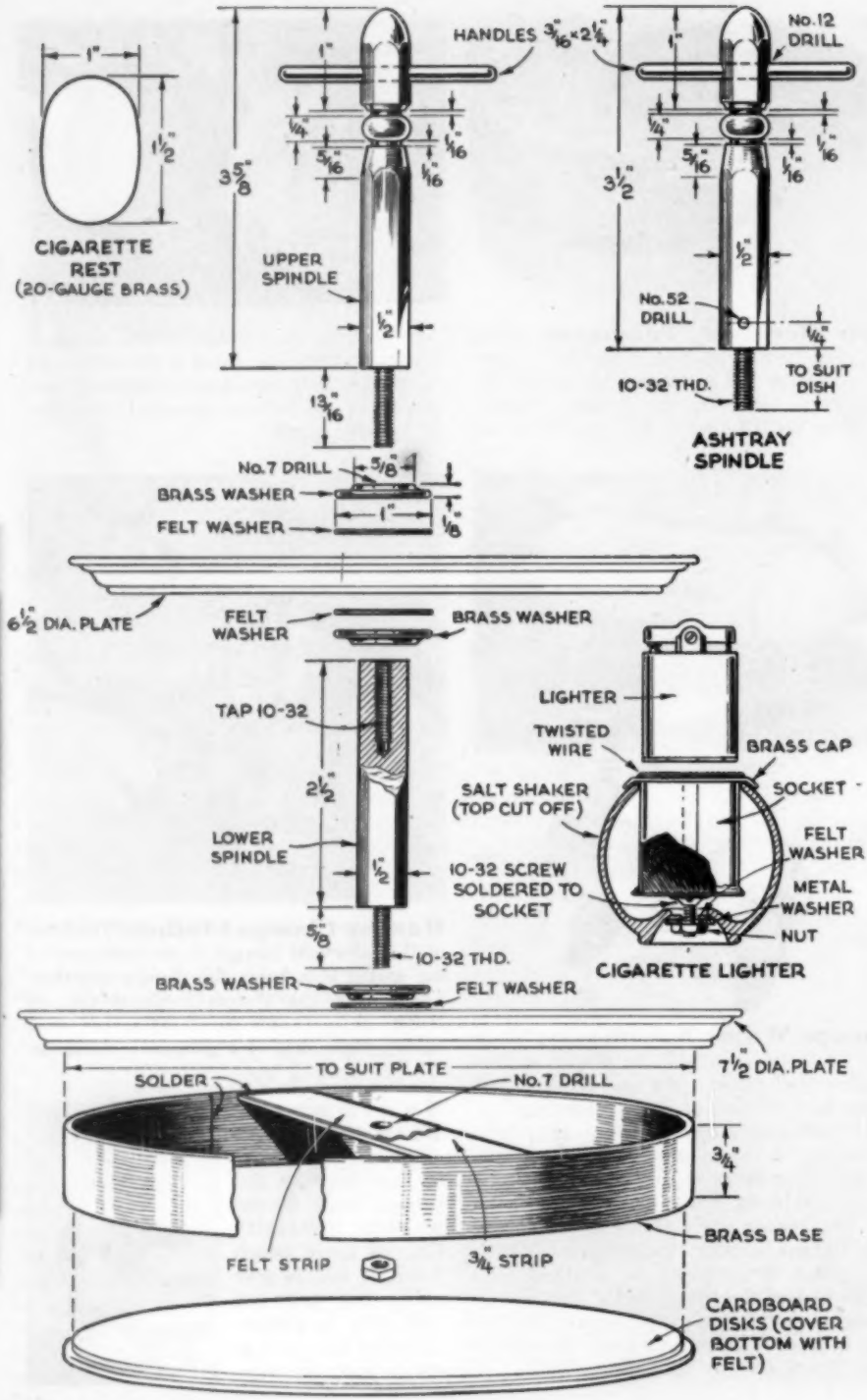


Pumps Water Noiselessly. There are no gears or cranks to clatter in this shallow-well pump. The one moving part turns in a cushion of rubber, insuring virtually silent operation. A ¼-h.p. motor protected by a thermostatic device runs the pump by a direct shaft connection. It is lubricated by the water that courses through it. Two models are available, rated at 250 and 400 gal. an hour. Weighing only 45 lb., the pump may quickly be attached to a tank. One of the advantages of this type of pump is that it starts pumping without being primed. The manufacturer is Robbins and Myers, Inc., of Springfield, Ohio.



Hanger Clamps Clothes. The hook of this all-metal hanger is an extension of the spring that holds the clamps together. The maker, the Perfect Products Co., of Beloit, Wis., claims the hanger will hold tightly, regardless of a garment's thickness.

Toothpaste Dispenser. An all-plastic toothpaste or shaving-cream dispenser, made by the Amogene Specialty Co., of Long Beach Calif., is said to save about five cents on each tube by squeezing all of the paste or cream from the tube.


1"
1½"
CIGARETTE REST (20-GAUGE BRASS)
HANDLES 3/16"×2¼"
1"
¼"
5/16"
1/16"
1/16"
3⅝"
UPPER SPINDLE
½"
13/16"
No.7 DRILL
⅝"
BRASS WASHER
FELT WASHER
1"
⅛"
No.12 DRILL
3½"
½"
No.52 DRILL
¼"
TO SUIT DISH
10-32 THD.
ASHTRAY SPINDLE
6½" DIA. PLATE
FELT WASHER
BRASS WASHER
TAP 10-32
2½"
LOWER SPINDLE
½"
10-32 SCREW SOLDERED TO SOCKET
⅝"
10-32 THD.
BRASS WASHER
FELT WASHER
LIGHTER
TWISTED WIRE
BRASS CAP
SALT SHAKER (TOP CUT OFF)
SOCKET
FELT WASHER
METAL WASHER
NUT
CIGARETTE LIGHTER
7½" DIA. PLATE
TO SUIT PLATE
SOLDER
No.7 DRILL
¾"
BRASS BASE
FELT STRIP
¾" STRIP
CARDBOARD DISKS (COVER BOTTOM WITH FELT)

New Gifts from Old China

By Bill Luther

AN ASHTRAY, table lighter, and double-decked candy dish make up this different and attractive cocktail threesome. To construct them you'll need a lathe, a hand grinder, and some old chinaware. I used two plates of different diameters, a sauce dish, and a saltcellar.

First step is to locate and mark the centers of the dishes on both sides. Grind holes at these points with a small pointed stone in a hand grinder. Hold the tool at a flat angle, as the tip does little cutting. Grind a little more than half-way through, reverse the plate, and finish from the other side. Moisten the work frequently. Holes through the plates can also be made with a vibrator-type engraving tool, or by the slower brass tube and abrasive method.

The grinder, however, is the preferred tool for altering the salt shaker into a base for the table lighter. Different shakers will present different problems, but the method illustrated can be adapted to most pieces. A thin abrasive disk is used to cut off the top of the shaker, and the wall is thinned down with a small grinding wheel.

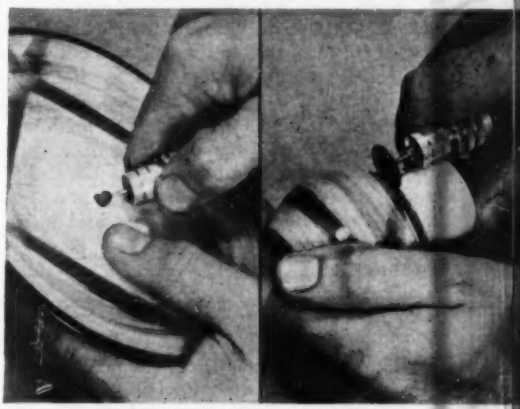
Spindles for the ashtray and candy dish are turned from ½" hexagonal brass rod; the one for the double-decker is made in two sections and screwed together. Shanks on the spindle sections are reduced to 3/16" and threaded 10-32.

Cigarette rests are cut from 1" squares of sheet brass. For the curved supporting arms, 1/16" brazing rod is used.

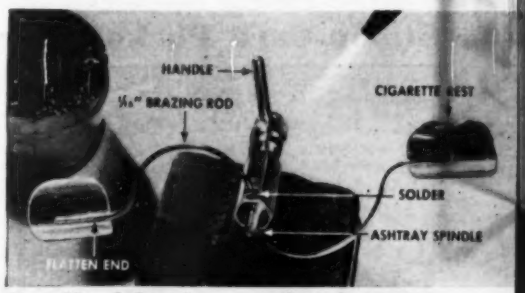
Both ends of the rod are flattened so that the cigarette rests can be held on with solder, and the rod is sweated in the spindle hole.

For the base of the candy dish a hoop was formed from a ¾" strip of 1/16" brass. Except for the bottom of the ashtray—where space didn't permit—a felt washer was used between each of the brass washers and the meeting face of the plates. The felt is ce-

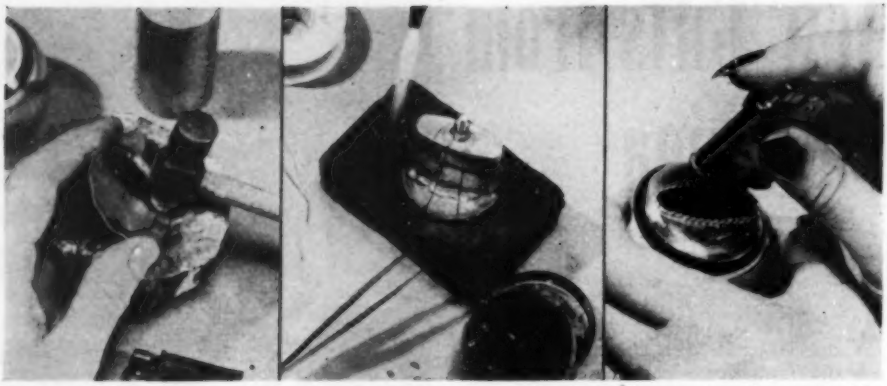
Three old dishes, a salt shaker, and some brass are the materials for this cocktail-table set.



A hand grinder is used both for drilling and cutting. Moisten the glazed china frequently.



Assembly of the ashtray spindle and cigarette rests can be clearly seen in this photograph.



A brass disk is used as a cap for the table lighter. Anneal the metal; then shape a flange with a ball-peen hammer. Bind the socket, cap, and a flathead screw together and solder them into a single unit. Note that the lighter can be easily slipped in or out of the socket.

mented directly to the brass. Cellulose cement is a suitable adhesive.

The top of the cigarette lighter is fashioned from a disk of 20-gauge brass about ⅜″ larger than the opening in the top of the salt shaker. In this case the diameter of the shaker top was 1½″, so the disk was cut 1⅞″. Anneal the metal by heating it red hot and letting it cool. Scribe the inner circle (1½″ in this case), hold the metal at an angle on a wood block, and hammer the outer edge with a ball-peen hammer. Anneal the metal again, place on a planishing stake or other smooth, rounded piece of metal, and hammer out the dents.

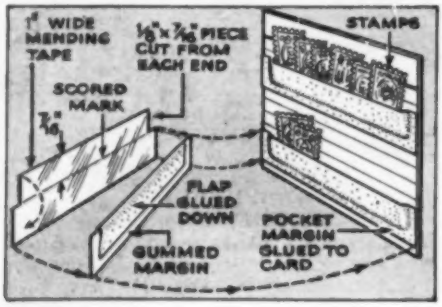
Smooth the edge by drawing it carefully along a flat file held on the bench. Most remaining hammer marks can be removed by filing, and low spots can be brought up by tapping from the underside. When the piece is smooth, buff with tripoli, followed with jeweler's rouge. Drill a hole through the center, insert a jeweler's saw blade, and cut out a slot for the lighter. Two strands of tightly twisted brass wire are formed into an oval and soldered neatly around the slot.

Wrap 20-gauge brass sheet around the lighter to form the socket, bind the shaped piece with wire, and solder the lap joint. A bottom piece of the same stock is soldered in. The socket is then soldered to the brass cap.

Polish the brass, wipe all parts with a cloth saturated with lacquer thinner, and coat with clear lacquer. Assemble the pieces as shown, taking care not to draw up too tightly on the threaded shanks. To finish the base of the tiered candy dish, cut two cardboard disks. One fits inside the base hoop; the other is the same diameter as the base. The cardboard pieces are cemented together and to the hoop, and the bottom is covered with felt.

The original cigarette lighter is not altered in any way. It is readily removed from the base for refilling or for pocket use. END

Stamp-Card Pockets Formed from Mending Tape



STOCK cards used by stamp collectors can be made up from file cards and 1″ transparent mending tape. Cellulose tapes that stick without wetting are harder to use.

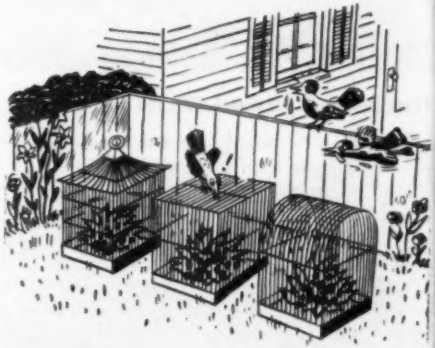
For each pocket, cut a strip of tape the width of the card. Score it with a pin or knife point as shown and fold along the scored line. Snip out a ⅛″ by 7/16″ oblong from each end, moisten the upper flap, and stick it down along the lower one. The gummed margin can then be moistened and applied.—*Pat Fey, Manhattan, N. Y.*

What's Your Ingenuity Quotient?

At last I know when to empty the icebox pan. I rigged a doorbell and a dry cell and placed the ends of the wires just below the rim of the pan. When the water reaches the wires, the bell rings. A dollop of salt in the water helps conductivity.—*Leslie Graves, Livingston Manor, N. Y.*

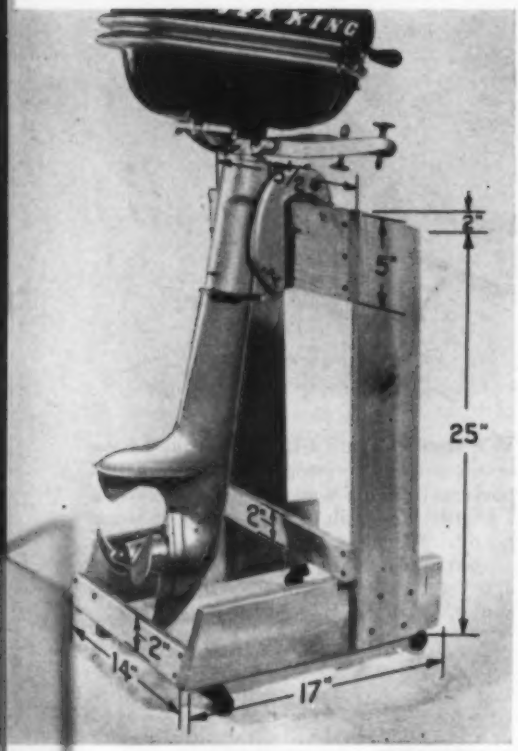
My job calls for about 1,000 miles of driving every week. That was okay until I began having a lot of trouble with vapor lock. I stopped that by squeezing a half grapefruit over the fuel pump. The fruit dried to form an insulating wall between the pump and the hot manifold.—*Fred Jones, Gainesville, Tex.*

We moved into a house that must have been occupied previously by hungry woodpeckers—the walls were full of holes. When I painted the walls, I kept a roll of tissue handy. Whenever I came to a hole, I sopped a wad of tissue in the paint, packed it in, and painted right over it. No holes now.—*Margaret E. Casson, Reseda, Calif.*



My strawberry plants were being used as a free lunch counter. Every time I glanced out the window I saw a gang of birds chomping on the berries. However, I broke up that act by removing the bottoms of old bird cages. They're fine plant guards. —*Roger M. Johnston, Glendale, Calif.*

Have you pulled off a smart one lately? We will pay for acceptable contributions showing ingenious solutions of problems in the home, shop, garage, or camp. It doesn't matter if it's wacky—if it works. Use government postcards only. Contributions cannot be acknowledged or returned.



Outboard Stand Built of Pine

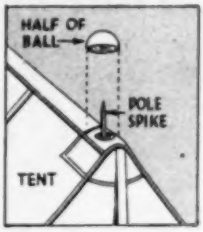
When an outboard motor is not in use, it is best to store it in an upright position. A stand on casters is ideal for this. The motor is held securely yet it is accessible from all angles for cleaning, lubricating, or overhaul work.

Random widths of ¾" pine were used to build the stand pictured above. The upright frame is positioned so that the weight of the motor is centered over the base. No. 8 wood screws 1¾" long were used throughout. Waterproof glue also was used.

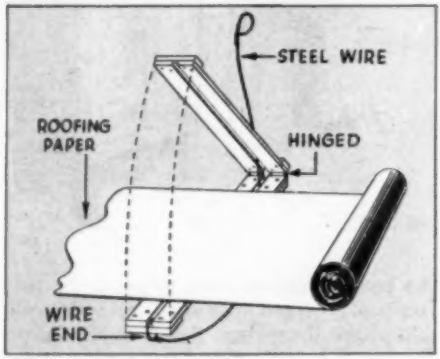
The only critical dimension is that from the top of the stand to the floor. Before you fasten the parts together, make certain that the finned propeller guard will clear the floor. Good-sized casters will increase your clearance and make for easy rolling.

With an attractive natural finish, the motor and stand will decorate a recreation room or den between seasons. Sand all surfaces smooth, apply a coat of shellac thinned with alcohol, and sand lightly with very fine paper. Apply one or two coats of varnish.—*Jed Robbins, Manhattan, N. Y.*

Rubber Ball Stops Tent Leaks



A sponge-rubber ball cut in half will solve the problem of a leak at the pole spike of a tent. Force a half of the ball over each spike, as shown in the sketch, so it will rest lightly against the canvas. Even if the spike projects through the ball, the soft rubber makes a seal around it. The balls may be left in place when poles are stored.



Roofing Paper Cut with Wire

This cutter for roofing and building paper is made of four 40" pieces of crating material. Space each pair of slats about ½" apart with a cleat at each end. Hinge one end as illustrated. Attach a steel wire at the other end. To cut, place the paper as shown, close the frame, and pull the wire.—*Victor H. Lamoy, Upper Jay, N. Y.*

Lipstick Tube Holds Eraser

A discarded lipstick tube makes a dust-tight holder for a draftsman's eraser. First clean any remaining lipstick from the holder. Then select a good-quality eraser and, with a razor blade, whittle it to a size that will fit snugly in the retractable section of the tube. Such an eraser holder will keep the rubber clean, even if it's carried in your pocket.—*Don G. Pittwood, Moscow, Id.*

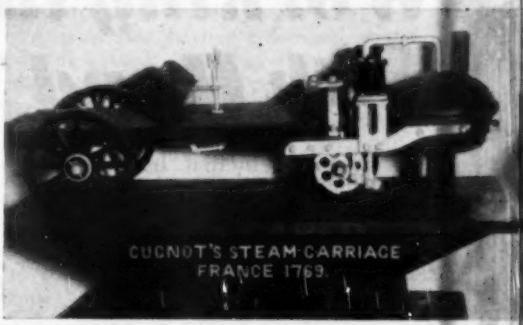
Ernest Warther puts finishing touches on a model of a Civil War engine carved of ivory.

Famous Locomotives Carved in Wood and Ivory

A HALF century ago neighbors referred to Ernest Warther as "that boy who whittles."

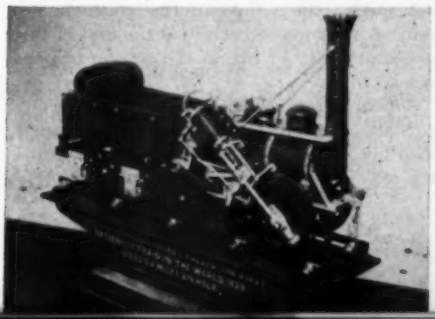
Today, at 63, Mr. Warther still is whittling. Carving scale models of locomotives is a full-time business with him now. His models, tracing the evolution of transportation on rails, reflect the skill and patience of a master craftsman.

In a workshop behind his Dover, Ohio, home he now is shaping his latest model—a locomotive carved entirely from ivory. The city of Dover has plans for a museum to house Mr. Warther's carvings. Besides locomotives, he has modeled ships and animals.

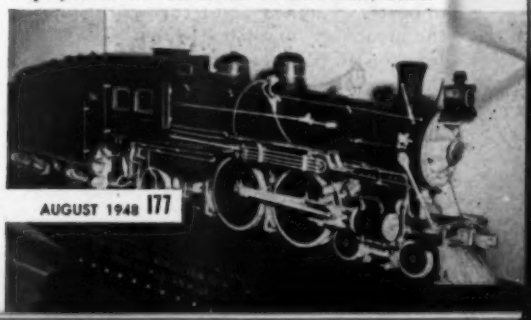


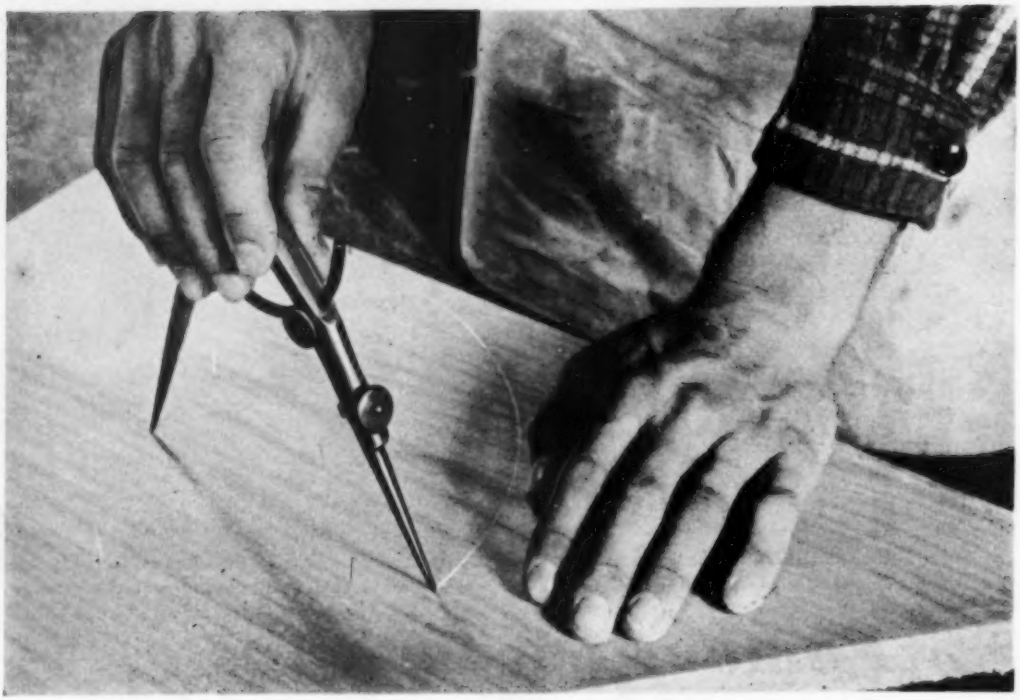
This wheeled nightmare, its boiler in a bustle, ran on roads instead of rails way back in 1769.

The first successful locomotive, the Rocket (1829), developed only 50 lb. boiler pressure.



A model of the Atlantic-type 4-4-2 locomotive displayed at the St. Louis World's Fair, 1904.





Working in the Round with Hand Tools

Care is the principal ingredient of well-cut circles and holes, but these tips on technique may also help.

By Edwin M. Love

FLAT surfaces and square edges are the bedrock of woodworking craftsmanship. But like the human skeleton or the framework of a building, they frequently gain in beauty by being concealed or covered. Previous articles in this series discussed the uses of bevels, chamfers, and recesses in relieving the monotony of squared edges. The same function is performed on larger pieces by the careful use of curves. In addition to lending grace to a project, curves and circles also have definite functional importance. Even a toy wagon would run poorly on square wheels.

Because circles are laid out with a compass, they are the easiest curves to draw and cut. Guide lines may be made with either a pencil compass or with dividers. The latter give greater accuracy because they scribe a fine line of uniform thickness.

Either instrument should be capable of remaining at its preset position without slipping; dividers especially may be thrown off their proper curve unless they are locked after being set. To set a pair of the kind illustrated above, loosen the locking screw and spread the points to the approximate span. A slow-motion screw at the end of the quadrant (Fig. 1) brings the setting to perfect accuracy.

A board from which a circle is to be cut is usually brought to thickness, but the back need not be smoothed because further planing may be required to remove splinters

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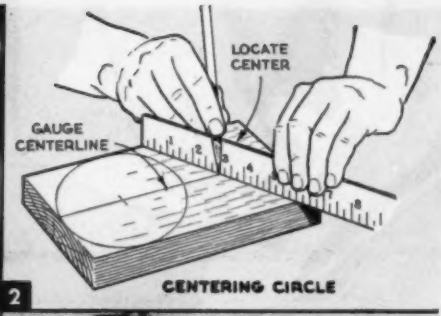
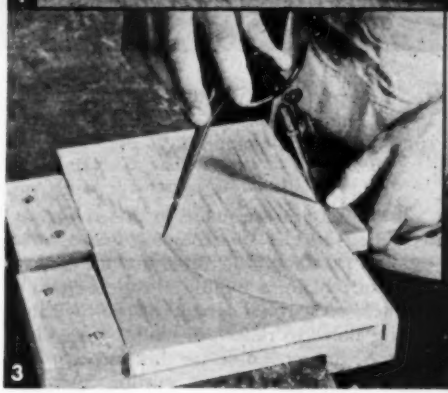


2 CENTERING CIRCLE



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kicked up by the saw. Press one point into the wood and pivot around it with the other to scribe a sharp line.

Marking the Centerline

Whenever a circle must be accurately placed on the work, its center has to be located carefully. In Fig. 2 it is tangent to both edges and one end. Tangent circles crop up frequently for several reasons. Tangency is necessary in cutting the largest possible disk from any given board or when an end is to be cut into a semicircle.

A standard method for gauging a center line is shown in Fig. 2. It consists simply of resting a rule obliquely across the face of a board at whatever angle gives an equal number of divisions. To avoid marring the work with a center prick, lay a piece of thin plastic or an old negative over the wood to pivot the divider.

Dividers are handy for stepping off uniform lengths on a board. Set the span, imprint the points on the piece, swing a leg around 180 deg., and mark that point. Continue to the end. If equal divisions are wanted regardless of length, estimate the span, and step off the work experimentally. Correct the span on each test until the right one is found.

A semicircle having a finished straight edge is scribed (as in Fig. 3) by holding a block against the edge to provide footing for the pivot point of the dividers.

Sawing a Circle

Circles can be cut with a number of different tools. A compass or keyhole saw may be used as in recessing an edge. Clamp the board upright in a bench vise, and shift its position as necessary. Remember that since the cut is rough a little material should be left outside the line for smoothing.

A coping saw with a wide blade is satisfactory even in rather thick wood. Thin and small work is best supported on a board notched with a deep V-cut (Fig. 4 inset) and clamped to the bench. Set the blade in the frame with the teeth pointing downward to draw the work against the support (Fig. 4). Turn the piece as required. A smoother cut can be made by inclining the saw forward than by holding it upright, but the slope must be regulated to fit the sharpness of the curve.

The small size of a block plane makes it

5

6

a handy tool to use in smoothing outside curves, as in Fig. 5. Sliding the fingers of the left hand against the wood while the plane rocks over the curve helps to keep the edge square with the face.

A curve that is left rough by unskillful sawing benefits by trimming with a chisel, as in Fig. 6. Downward pressure on the handle, coupled with a sidelong swing of the edge, quickly removes ridges and tears in the grain.

Smoothing the Edge

The use of a spokeshave is illustrated in Fig. 7. It is a double-handled frame that has a keen blade clamped in the opening. Though it operates like a plane, the short sole of this tool enables it to slide freely over an outside or an inside curve. It may be pushed or pulled. On wide lumber (1″ or more) give it a shearing sidewise motion while stroking it forward. Blade projection is set by sighting across the sole, or by resting the frame on a board, inserting the blade, and pressing down while tightening the set-screw. The latter setting gives a thin shaving suitable for final smoothing.

Inside Circles

Inside circles are made in the same way as outside circles. Leave some waste wood to allow for smoothing. A cabinet file is often the best tool for smoothing inside curves.

Enclosed circles cannot be cut without boring holes to receive a blade. Auger bits (Fig. 8) are most used for this purpose. The traditional type has two cutting lips, two spurs for trimming the outside of the hole, and a threaded, tapered point. Chips are lifted with a single or double worm. A square end on the shank gives the brace a positive grip. The Forstner bit substitutes an edged rim for the spur. Because the rim is supported by the groove it makes, this bit will cut an arc from the edge of a board or bore without deflection through wood having hard spots, such as knots. The twist drill is useful for boring where nails might be

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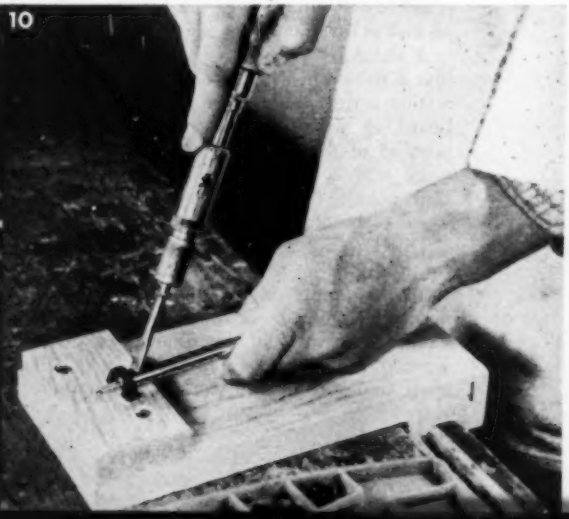

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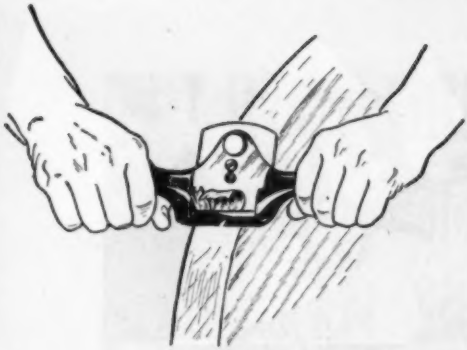
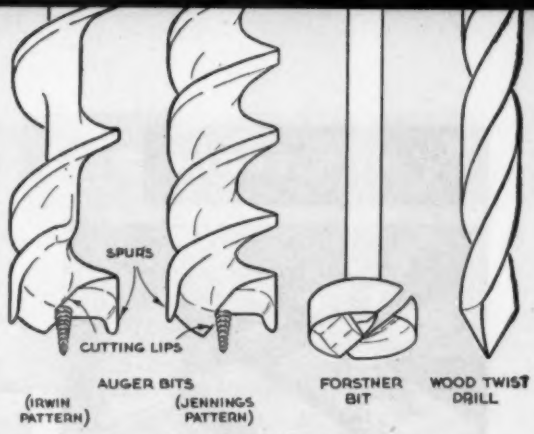


7 USING SPOKESHAVE



8 WOOD BIT TYPES

encountered, but is available only in small sizes graduated in 1/32″ steps.

As large bits are costly, holes above 1¼″ in diameter are usually bored with an expansive bit, illustrated in Fig. 9. It is especially useful for boring odd-sized holes, since the wing cutter can be set at any desired fraction. If the diameter of the hole must be accurate, try the setting on scrap and measure the test cut. Sets of bits having interchangeable cutters are now on the market. One such is shown in Fig. 10.

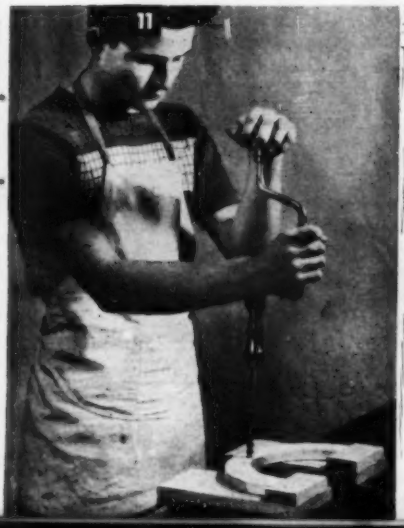
Braces are made in a variety of styles and sweeps. A good size has a 10″ sweep or circle of hand movement. Many models can be set for ratcheting.

Boring a Hole

Center a bore by stabbing the screw point lightly into the board at the mark. If it slips off a hard grain into soft wood beside it (as may happen in fir) or if the wood is so hard that the point will not readily enter, punch a starting hole with an awl. Use a punch to start also if the threaded tip is old or worn. Rest the work on blocks to protect the bench top (Fig. 11), hold the bit upright, and turn the brace. Heavy pressure is not ordinarily needed on the top of the brace, since the threaded bit point feeds the cutting edges into the wood. When the hole is nearly through (Fig. 12) and so much of the point projects that it stops feeding, turn the work over and finish boring from the other side. If too much pressure is applied when the cut is nearly through, the bit may crash through the rest of the way and splinter the underside.

Keeping Bits Sharp

Dull bits do not perform any better than dull planes. Purchase a bit file to keep with the kit and use it to restore the keen edges as shown in Fig. 13. File cutting lips from the top and spurs from the inside. If a bit spur has been filed away, or even filed on the outside, the bit is useless and should be discarded. END



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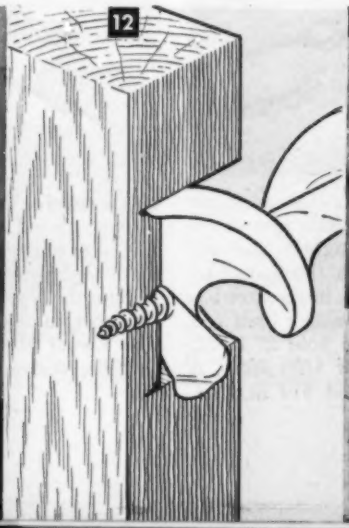

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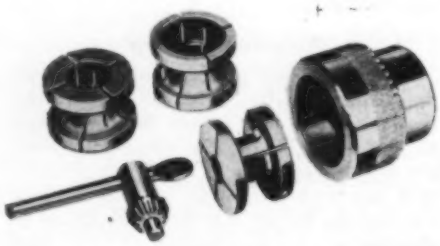
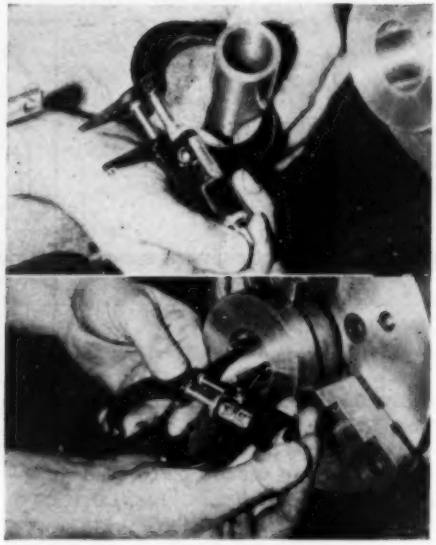
NEW TOOLS

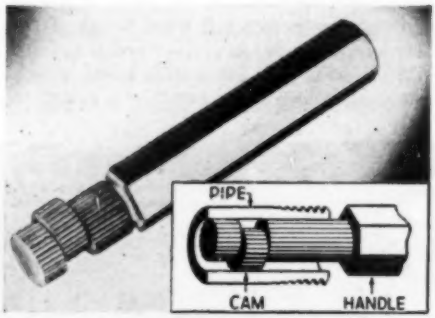
Brazing Kit Has Heat Chamber. Offered by the American Products Corp., Chicago, this compact outfit contains all necessary materials and equipment for light bench brazing. The heat-retaining chamber, pinned together of asbestos board, permits handling fair-sized jobs with a small torch. Also included are an alcohol torch, fuel, flux, and assorted silver solder. It sells for about $7.50.



Lathe Collet Chuck. Threaded on the spindle nose of a lathe, this new collet chuck grips round stock tightly and accurately. It's supplied with three double-ended collets that take work in six sizes between ½" and 1½", and the chuck itself can be used without a collet to hold 2" stock. Made by Martin Chuck, of Milwaukee, it costs about $12 in alloy and $19 in steel.

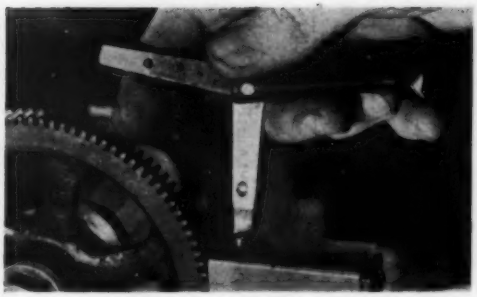


Micrometer Does Double Duty. With this instrument, developed by the Richards Machine Tool Company, of Glendale, Calif., you may take either inside or outside measurements at will. Any setting of the external calipers automatically is the same on the internal calipers, permitting direct comparison of mating or telescoping parts. The measuring screw is hardened and the thread ground for long life and accuracy. Several different sizes are made.



Eccentric Wrench Holds Pipe. When inserted in a pipe or nipple and revolved in either direction, the center serrate section of this wrench swings cam-like to engage the inside of the pipe. It is turned by either an open-end or adjustable wrench. The Kiener Machine Products Co., of Los Angeles, makes the tool to retail for about $2.

Husky Little Screwdriver Folds to Pocket Size

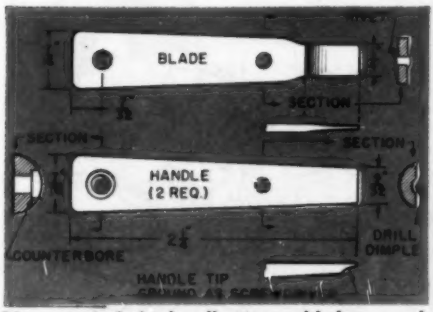


ALTHOUGH only about the size of a penknife, this folding screwdriver is rugged enough for really heavy work. The blade is sandwiched between two pieces of tapered steel that may be used as blades themselves.

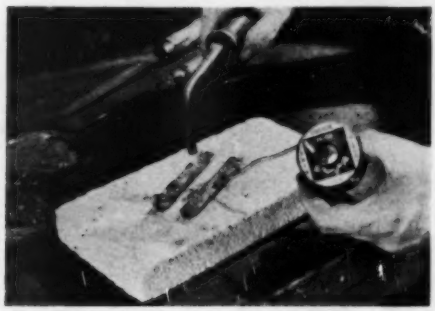
With a hacksaw, thin abrasive disk, or slitting saw in a milling machine, split lengthwise a 4″ piece of ½″ drill rod. File the two cut surfaces if you've used a hacksaw. Soft-solder the two halves together in their original position. Then chuck the assembly, taper 2¼″ of it as shown in the drawing, and cut off. Drill and counterbore a hole for a steel rivet that acts as a pivot. Heat the pieces to separate them, wipe off all solder, and round the sharp edges.

Using a handle piece as a pattern, make the blade of ⅛″ steel. Grind the blade tip as a screwdriver and drill the pivot hole. Drill a second hole ¾″ from the tip, using a 1/16″ or 3/32″ bit. Temporarily assemble the parts and use the second hole as a guide for spotting dimples on the inside surface of the handle pieces. Peen over the ends of a steel rivet in the blade hole and file them down until they project no more than 1/64″. These projections will fit into the dimples to keep the tool closed.

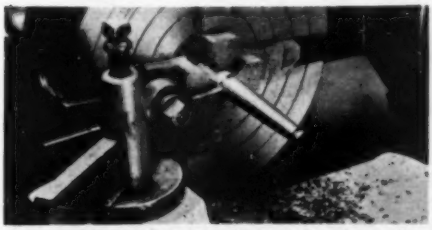
Harden and temper the handle and blade. With the ends of the handle pieces shaped as blades, you'll have three blade sizes in one tool.—*Walter E. Burton, Akron, Ohio.*



If you grind the handle tips as blades, round off the corners to prevent wear on your pocket.

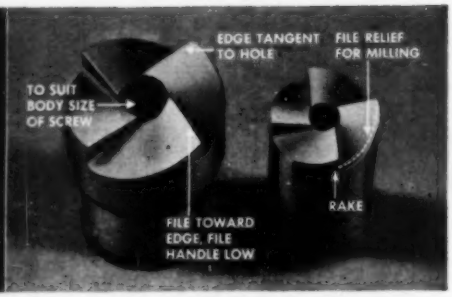


Use soft solder to assemble the two halves of the drill rod before turning them for handles.



Cutting off handle assembly. Tailstock, used as outboard support, was moved for photograph.

Here are the four parts of the folding screwdriver. Smooth all edges with abrasive cloth.

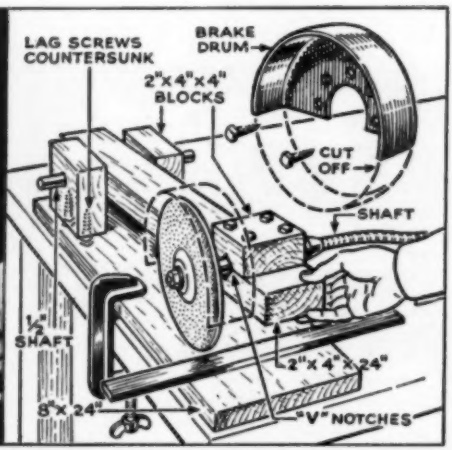


Mill Makes Screws. Modelmakers and others who occasionally have to make up a few special screws will find hollow end mills a great convenience. They are particularly useful in making small screws—4-40, 3-48, 2-56, and the like.

To make a mill, chuck a length of drill rod, face, and centerdrill the end. Run in a hole about 1″ deep, using a drill the same diameter as the screws to be made. Cut off and clamp the blank in a vise, face up. Scribe four lines tangent to the hole 90 deg. apart. With a fine file held parallel to the line nearest you, form a single cutting edge or tooth. File three others the same way.

Then chuck the mill in the drill press. While it is rotating, bring it lightly against a flat oilstone. File the slight flats thus formed just to the point of disappearance. Rake is formed by undercutting the teeth with a three-cornered file. For use as a side mill, file edge relief as shown.

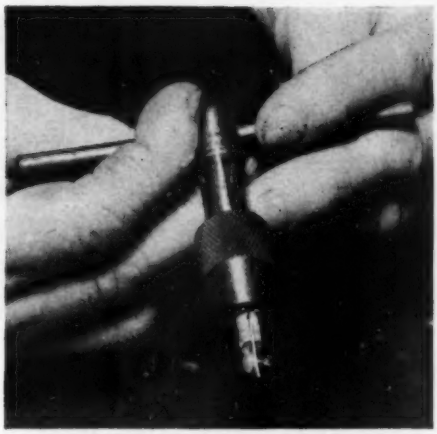
Heat the mill to cherry, quench, and temper by gently reheating the shank and requenching at a light straw. Dress the teeth with a fine stone. To use, chuck the mill in the tailstock and feed it against suitable rod revolving in the headstock. At left above are various pieces of shouldered hex rod and finished screws.



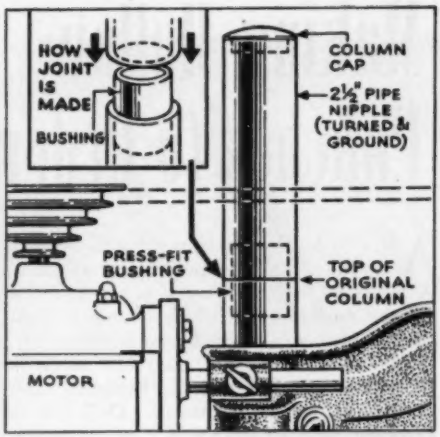
Improvised Metal Cutter. The power metal cutter pictured above was made of a flexible shaft, a saw-gumming wheel, and scrap lumber. If the shaft speed is high enough, a flexible abrasive cutoff wheel may be substituted. Follow the speed directions printed on the wheel's label.

To protect my face and body in case the wheel should break, I wore a heavy plastic grinding shield and a thick jacket. A better precaution is a wheel guard cut from an old brake drum, as shown in the drawing, and screwed to the arm and block holding the shaft.

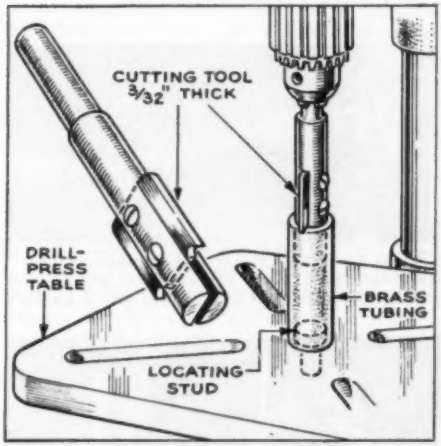
The base of the cutter is a 1″ board. The 2″ by 4″ by 4″ blocks act as bearings for the ½″ shaft. The shaft, in turn, acts as a pivot for the 24″ movable arm. Work should be clamped or otherwise firmly held under the wheel.—*Don G. Pittwood, Moscow, Id.*



Small Objects Held by Dowel. An excellent holder for small objects that are to be ground or polished can be made from a short split dowel. Insert the dowel in the jaws of a tap wrench. Then place the work in the slit of the dowel and tighten the chuck. Small screws also can be held in a split dowel when cutting off the heads and re-slotting.—*H. Klein, Pittsburgh.*

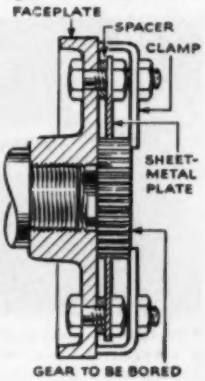


Drill Press Extended. I modified my drill press to handle a wider variety of work by extending the drill-stand column. A 12" long pipe nipple of suitable diameter was turned and ground to exact size on the lathe. Then I made a bushing to fit the column and pressed the extension on the bushing. Now the press head can be raised 12" higher. The extension does not interfere with work on small jobs.—*Carl Jean, Parker, Ind.*



Tool Removes Burrs. We were cutting brass tubing into short lengths and needed a tool to remove burrs from the ends. The tool we made is shown in the sketch. It is a 4½" piece of cold-rolled shafting with a 3/32" slot milled 2" from one end. Two notches with cutting edges were filed in a piece of 3/32" tool steel that was clamped in the slot. The tool was used at high speed.—*Hugo Youngstrand, Chicago.*

Gear Bored Without Three-Jaw. Here's an accurate method of enlarging the bores of stock gears, requiring no indicator. Using snips, cut a circle of sheet metal 1" less in diameter than the faceplate. Bolt it to the plate, using spacers. Bore a hole in the sheet metal a close fit for the gear, without any shake or play. Clamp the gear in place with extra nuts on the same bolts as shown, taking care not to loosen or shift the sheet metal.—*M. Duhamel, Lachine, Que.*



Making Hollow Punches to Order

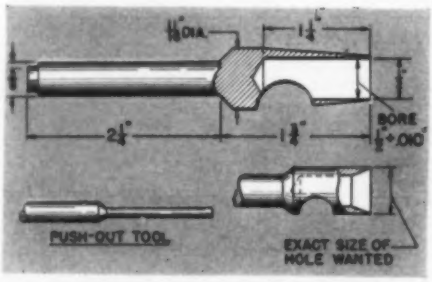
A SET of hollow punches, besides being a useful addition to any shop, is an interesting lathe project. The tools are used for cutting neat holes in many materials from thin sheet metals to leather and paper.

The most commonly used raw stock is tool-steel rod that can be hardened and tempered by heat treatment. Drill rod is excellent for most purposes. Cut the punch blank to approximate the finished tool, leaving just enough extra metal to let you face the ends. Make the diameter about 30 percent larger than the hole the punch is to cut.

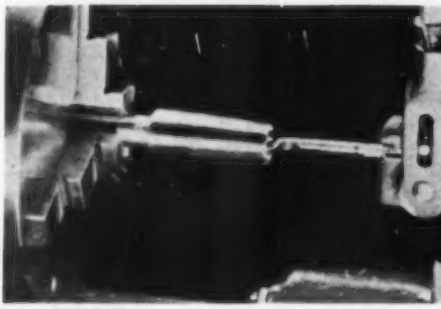
Chuck the blank so the handle portion—about 2½"—projects. Turn the handle to the desired diameter. I've found that ⅜" is about right for punches making 5/16" holes and larger. You may leave the handle smooth but knurling gives a better grip.

A good idea at this point is to reduce the head for ⅛" as on the punches shown on the opposite page. Such reduction retards the tendency of the end to mushroom.

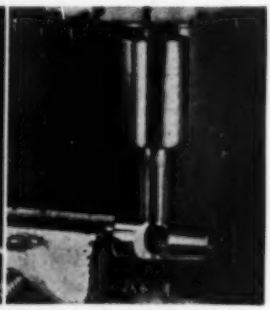
To make the cutting end, turn the blank around, face off the end, spot it with a center drill, and drill the cutting recess. Use a bit slightly smaller than the final diameter is to be. For example, in making a ½" punch, first drill it with a 15/32" bit. For the final diameter, use a boring tool. Then set the boring tool to cut .010" oversize. Continue at that setting for the full length of the cutting recess. Of the two punch shapes shown, the upper one will produce uniform disks and the lower one uniform holes.



When you drill the body of a punch, use a bit slightly smaller than the hole the punch is to make. Example: For a ½" punch, drill it 15/32".



The drilled hole is enlarged to final size with a boring bar. Also use the bar to relieve the cutting edge by making bore slightly oversize.



An end mill is used to cut the side opening in a punch. This outlet for the punched pieces may also be made by hand with a hacksaw and files.

Machine the outside of the punch body to taper to the cutting edge. The outside diameter is not particularly important as long as it is enough to give the punch walls sufficient strength. Then smooth all surfaces with a file and abrasive cloth. Carefully dress down the cutting edge but do not make it too thin.

The side opening, an outlet for the cuttings, may be made with a hacksaw and round files; or it may be cut with an end mill.

Use numbered punches or an engraving tool to mark the size on the handle or on the straight portion of the body. The finished punches pictured on the opposite page also have been marked CR or TS to indicate they were made of cold-rolled or tool steel.

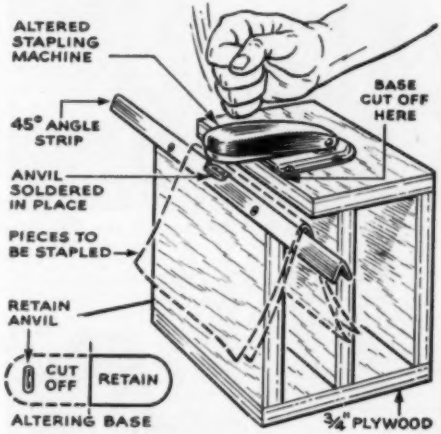
If you use an alloy tool steel, follow the manufacturer's directions for hardening and tempering. If you use ordinary drill rod, this procedure usually gives satisfactory results: Heat the cutting end for about ½" until it is cherry. Then quench in water. Polish a spot on the hardened surface and reheat slowly in a gas flame until a uniform blue film forms. Then let it cool without quenching. Harden and temper the head in the same way.—*W. E. Burton, Akron, O.*

Finished punches. At left is the simplest form. Others are, from left to right, ¼", ⅜", and ½".

Hand Stapler for Booklets

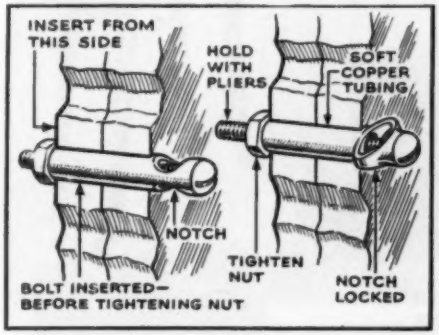
OWNERS of duplicating machines or small print shops without commercial stapling machines will find this inexpensive setup satisfactory for folders and booklets. Alter a hand stapler as shown, retaining the anvil. Solder the anvil in a recess cut in the 45-deg. angle iron. Cut the top of the front piece to accommodate the angle iron. Attach the iron with some flathead screws countersunk to let the paper slide over.

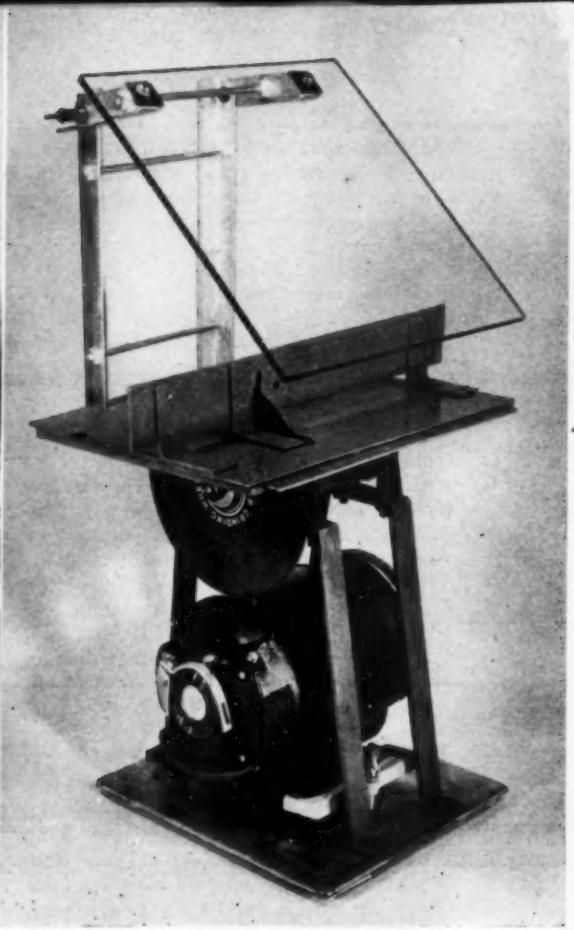
Line up the stapling machine by pushing a staple half out and moving the upper part around until the staple is exactly over the anvil. Then fasten the stapler down with screws through holes drilled in the base.—*Edgar W. Ralston, Bordentown, N. J.*



Tube Makes Toggle Bolt

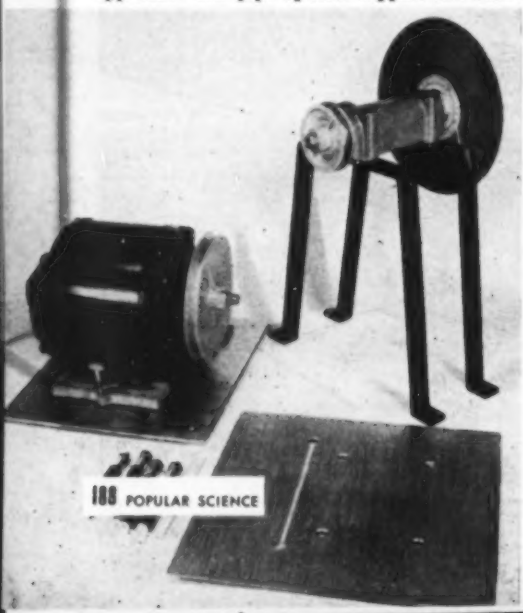
HERE'S a blind bolt for attaching parts to walls, pipes, or other spots where both ends of a bolt are not accessible. Notch an appropriate length of copper tubing as shown. Insert from the notched end a slightly longer bolt with a head about the same diameter as the outside of the tube. Place this assembly in a hole drilled in the parts to be joined. Then hold the threaded end with pliers and tighten the nut until the notched end flares out and holds securely.—*Don G. Pittwood, Moscow, Id.*



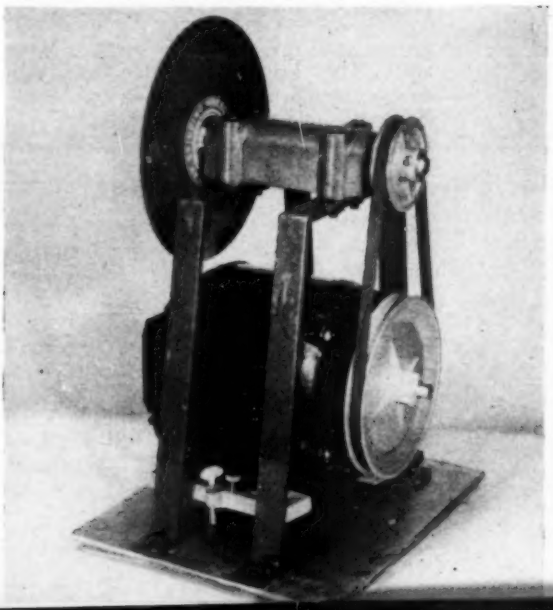


Spinning at nearly 4,000 r.p.m., the thin-edged wheel munches through almost any metal.

Disassembled, the unit's simple construction is apparent. The pipe spacers support the table.



A pivoting motor mount permits easy adjustment of belt tension. The drive uses a 22" V-belt.



Homemade Cut-Off Wheel Slices Steel

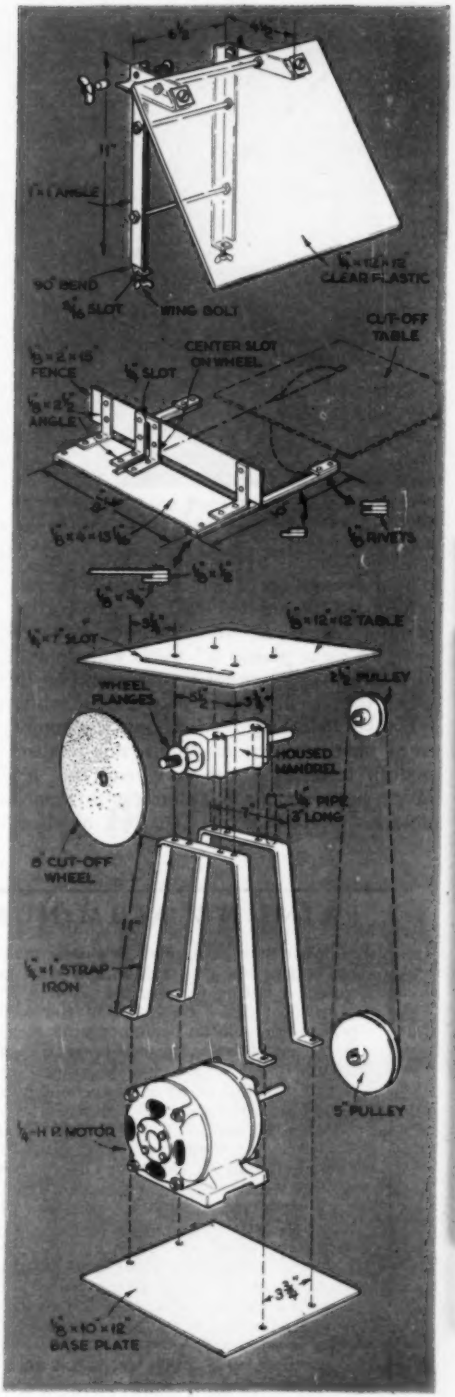
This sweat-saving shop tool will put cobwebs on your hacksaw. It'll chew through almost anything you feed it.

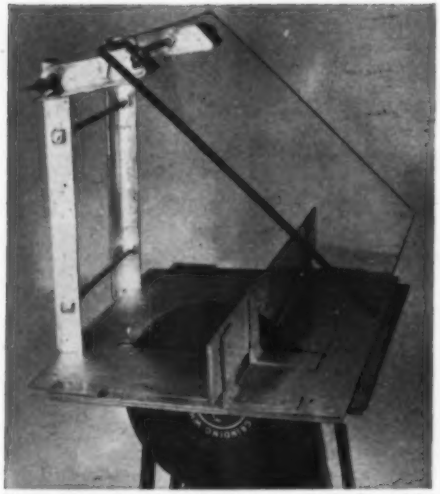
By Jack Mellinger

IF YOU'VE recently muscled your way through a big chunk of metal with a hacksaw, you'll appreciate this cut-off wheel. The thin abrasive disk will chew its way through angle stock or pipe in a matter of seconds, leaving a smooth cut. In our shop we've also used it to trim flowerpots, cut armored cable, rough out radio panels and chassis, and whack off extra metal from castings. By rough-cutting stock before machining, it will save work time on a shaper or milling machine.

The wheel turns on a ball-bearing mandrel with a ½" shaft, picked up for about $6. For power, a ¼-hp. AC motor turning at 1,750 r.p.m. will do. Belt it to turn the wheel at 3,500 to 4,000 r.p.m. A pivoted belt-tightening type of motor base is convenient for holding the motor on the base plate. Use an 8" cut-off wheel of the type labeled for mild steel and pipe.

Most of the rest of the material is common shop iron. You'll probably want to do some hot bending with a torch or forge to shape the table supports. One way to cut the table slot is to drill two holes at the slot ends and then hacksaw out a strip between them, finishing off the edges with a file. The work guide should slide freely but not too loosely on the table, and should be slotted so that the fence can be pushed right up to the vertical center line of the wheel. It's a good plan to leave the gap shown beneath the fence; it'll let you stick a small C-clamp under the work as well as over it





Eye protection is afforded by the adjustable shield, a clear plastic panel that's ¼" thick.

Pushed forward by the guide, a pipe is quickly cut. The guide helps feed the work in straight.

to hold workpieces of odd or irregular shape.

A guard should be used to protect the operator, since the wheel throws grit. A panel of clear plastic ¼" thick will do the job. The guard bracket can be clamped to either the back or one side of the table.

Unlike older rigid wheels which sometimes shattered under slight side thrust, modern rubberized cut-off wheels are not dangerous when used according to manufacturers' specifications. Too high a wheel speed is of course hazardous, but the maximum speed is generally labeled.

Don't forget that as the wheel wears and its diameter decreases, the peripheral speed and hence the effective cutting rate will also fall off somewhat. If you aren't familiar with cut-off wheels, you may have a tendency to "take things easy" to minimize wheel wear. Actually you should feed the work into the wheel as fast as it will take it; the wheel will last longer this way. END

PAINTING ALUMINUM [PAINTING]

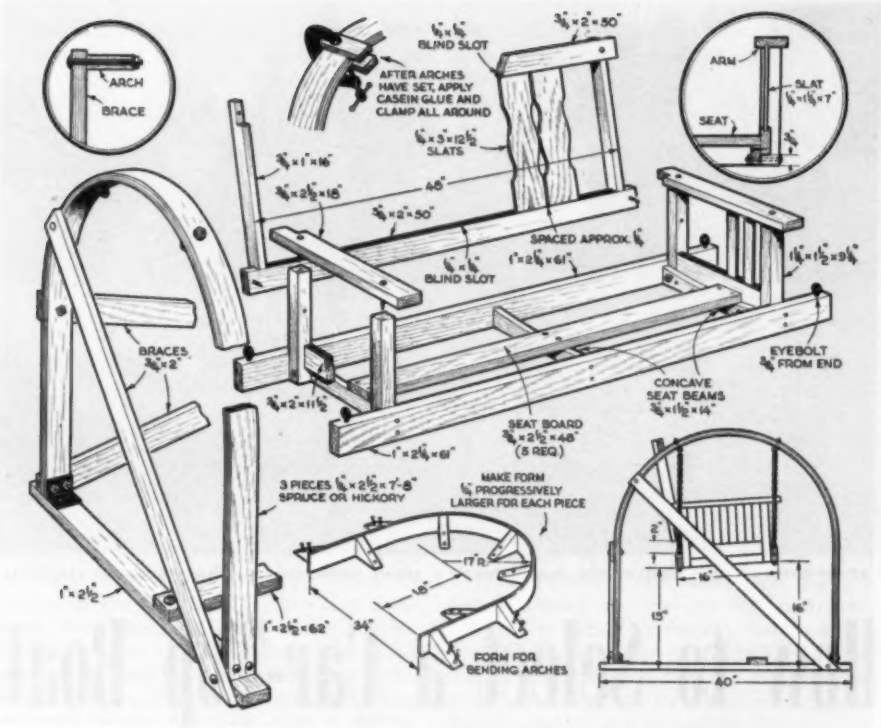
PAINT may be applied to aluminum alloys to improve their appearance and provide protection, but the surface first must be carefully prepared. Otherwise, you cannot expect a lasting job, for the paint will not reliably adhere to the metal.

In most cases, treatment of the surface with a water solution containing a little phosphoric acid and some organic grease solvents will give a good base for the paint. A solvent cleaner also may be used, but this is less effective than the phosphoric acid treatment. If the parts to be painted are constantly subjected to moisture, The Aluminum Company of America recommends use of its Alrok ⓣ oxide coating to promote adhesion of the paint.

After the surface has been treated and allowed to dry, a priming paint should be applied. A primer containing a substantial quantity of zinc chromate pigment has been found to be the most effective on aluminum, particularly if the metal is to be subjected to severe climatic conditions. However, an aluminum paint made by mixing aluminum paste with a suitable varnish vehicle also will do the job. If a lacquer finishing coat is to be applied, a special primer recommended for the particular lacquer should be used.

In cases where the color is satisfactory, aluminum paint is excellent as the finishing coat because of a high impermeability to moisture. However, any finishing paint that is satisfactory for other metals may be used to good advantage. A bituminous paint is recommended if the alloys are to be in contact with an alkali-containing material, such as mortar.

POPULAR SCIENCE MONTHLY SHOP DATA

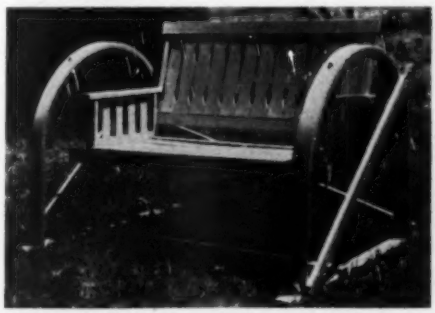


Porch Seat Keeps You in the Swing

THIS low-slung, comfortable swing seat will make any shady spot on a lawn or porch more inviting. It's simple enough to be built in a home workshop equipped with a circular saw; a bandsaw or jigsaw for cutting the contoured slats will also help.

In the original, each of the supporting arches was steamed and bent from ¾" stock, but they can also be made of thinner wood. Three ¾" by 2½" by 7'8" lengths of hickory or spruce will do nicely. Soak them overnight in a pond or trough and put them in a bending jig as shown until dry. The outer stakes of the form will have to be moved back ¼" for each piece. Allow a little extra length so that the ends can be trimmed square after the laminations are glued.

Chains are hung on eyebolts, and the swing can be adjusted for maximum comfort. Note that the seat is concave with slats running end to end. Narrow slats conform best to the concave shape. The frame is reinforced with cross braces on the back and diagonals on the arches. Screws and carriage bolts are used throughout. If the hardware is rustproof the unit may be left unpainted to take on an attractive weather stain.—*Hi Sibley, Nuevo, Calif.*



Suspended from the arched supports, this porch seat has the gentle sway of a rocking chair.

Canvas-covered, this lightweight model takes a small outboard and has excellent stability.

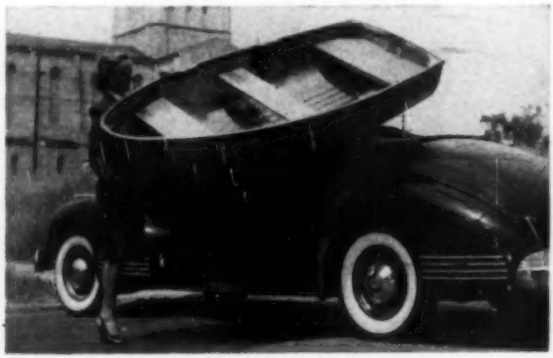
How to Select a Car-Top Boat

By J. A. Emmett

IF YOU'RE thinking of buying or building a boat for car-top carrying, here's a word of caution. You can carry any boat that's light enough for easy handling, but unless it's designed especially for such use you'll probably come out on the short end of the deal. Just any old boat you happen to pick up will seldom give satisfaction.

Many of the new plywood, plastic, aluminum, and canvas-covered boats were developed specifically for this purpose. As any boat should, they give dependable service in the water. But over and above this, they have features ordinary boats do not.

Plastic construction allows a wide latitude in design. Note the flowing lines of this model.



Easily handled, this 7′ molded plywood craft weighs only 56 lb. A wide beam makes it safe.

Although lightness is the primary consideration, it's by no means the only one. In most cases 100 lb. is the allowable limit. If a boat meets the weight requirement, you should also ask these questions:

Is the boat compact enough to be carried without hampering your driving?

Is the hull shaped to minimize wind resistance when overturned atop the car and at the same time retain all the stability you'll need in fairly rough water?

Will the boat withstand knocks that may occur while it's being lifted on and off the car—as well as occasional dragging when you can't drive to the water's edge?

Will the seating and load capacity be sufficient for your purposes?

Will the boat remain watertight when it's alternately exposed to the sun and soaked in water?

The ordinary wood boat practically always falls short on the latter score. For tightness, it depends to a great extent on the tendency of wet wood to swell. When it's carried in the sun, the waterproofing treatment that has been used—calking, filler, backing battens, or the shaping of the plank edges—may keep the boat usable for a while. But in time, you'll find it necessary to allow the boat several hours—or even a day or more—to swell tight. This time lapse would make the boat unusable on brief outings.

Because of the prices asked for commercial models—roughly anywhere from $60 to $180—you may want to build your own. Waterproof plywood offers the most practical material. The molded plywood, plastic, and metal alloy types are out of the question in most home shops, of course, and the necessity of steam-bending ribs makes the canvas-covered boat a difficult job.

A skiff or pram model is the most likely possibility for home building. But before beginning, be sure the plans you've picked are for a true car-type, not just a boat.

Most manufacturers who use panel plywood list flat-bottom skiffs as suitable for car-top carrying. These range from 8′ to 12′ with a beam of 48″ to 52″, the stern is usually wide enough so that the boat does not squat badly under a small outboard, and the bow is slightly fuller than the average skiff. Depending on the length, such a boat will accommodate up to four persons.

The weight may vary anywhere from 50 to 100 lb. On this point, it is important to see that the weight was not kept down by skimping on the hull framing. Despite the inherent strength of plywood, it must be properly backed by side frames and stiffened by long fore and aft members.

A pram type made of plywood also serves well, chiefly because its square bow gives a hull affording maximum load for the length. Some models are flat bottomed, others are slightly V-shaped, but in either case the bottom also is slightly rockered. Those with V-shaped bottoms are apt to be more expensive, but have the advantage of being easier to row or handle.

Although it can't be called a true car-top type, a plywood duck boat is worth considering if you want a hunting craft or an easily propelled hull for marsh use. Even in a 15′ length, the weight usually is well under 100 lb. For short trips, the overhang of its low ends is not as great a detriment to driving as might be thought.

Used for years in canoes, canvas covering can be said to have first made possible a

In the water, this 12′ plastic boat handles easily. Some boats of this construction tend to be a little heavy for their size. A special carrier above minimizes the amount of lifting.

Built by the author, this canvas-covered model is satisfactory—but required painstaking work.

A molded plywood hunting boat like this will nestle low atop the car. It weighs about 50 lb.

true car-top boat. Since there's greater design latitude than with wood construction, the bottom can be rounded and full lines carried well forward and aft. This gives the boat a greater carrying capacity.

Although such boats are light, they're not likely to leak or change shape even after years of service. Good workmanship and proper materials are required, however. This explains the rather high prices asked. But if the outlay is spread over the potential life of such a boat—10 or 15 years—the yearly cost is quite low.

The tendency of paint on the covering to check after a few years may be considered the only disadvantage of this type. Better builders have been largely avoiding this of late years by proper preparation of the canvas. Should the covering be torn, repairs can be quickly made with hard canoe glue and a hot iron. Moreover, if it ever should be necessary, the covering can be completely renewed by the owner.

In canvas-covered craft, there is little advantage in going below a 10′ or 12′ length. Anything shorter is likely to be more of the yacht type, not as easily handled in the water as longer craft.

Canoes should be considered in this bracket too—especially the short and beamy trapping, hunting, and carrying types and the square-sterned models designed for outboard use. A 14′ modified canoe with 37″ beam, perhaps fitted with air chambers to increase stability, need not exceed 100 lb.

If you prefer a canoe, this 13′ aluminum job weighs only 38 lb. and can be carried by car.

Boats built of plywood panels should not be confused with those actually molded of plywood. Here, layers of thin veneers are laid at different angles over a master form or inside a mold, each with a coating of plastic glue. Subjected to heat and pressure, the material is molded into a one-piece shell, complete with a bonded keelson, stem, and perhaps other members.

Completing the boat is then a matter of fitting the gunwales, seats, and such members of the framework as couldn't be included in the molding. The result is a boat equal in appearance to a piece of fine furniture. In hull design, an even greater latitude is possible than with the canvas-covered type. Molded plywood boats usually have a rounded or barrel-type bow instead of the customary sharp stem.

There's great promise in small craft molded of plastic materials, aluminum alloy, and other lightweight metals. Here, there's absolutely no limit on design possibilities, and some such craft already have appeared with compound curves. It may be said, however, that this method of construction has just emerged from the experimental stage. It needs a few years of actual use for proper evaluation.

So far as metal construction is concerned, there's still an apparent need for a workable lightweight alloy that will truly resist salt-water corrosion without depending on a surface finish of paint.

Whatever its type, any car-top boat requires a good carrier or means of mounting. There are many good makes on the market, reasonably priced at around $10. Rather than shop around, you'd probably be wise to buy a carrier from the builder of your boat. More than likely, he has chosen a style that best suits the particular type. END

Compact Enlarger Yields Fine Prints

It's equipped with condensers and handles any negative up to 2¼″ by 2¼″. Gear focusing gives vernier sharpness.

By Leonard J. Bogert

The lamp house is a photoflood reflector of 6″ diameter.

FOCUSED with a rack-and-pinion adjustment, this condenser enlarger gives consistently sharp prints. As dimensioned here, it accepts any negative up to 2¼″ by 2¼″. This maximum could be raised to 2¼″ by 3¼″, however, simply by installing larger condensers and increasing the film-holder apertures.

When you consider the prices usually asked for condenser enlargers, the cost of building this one was surprisingly low. Even if you must buy all the parts—including a lens, condensers, bellows, and a 6″ photoflood reflector—a little judicious shopping should enable you to keep the total expenditure under $20.

In either results or appearance, I'd stack it against most ready-made enlargers. I do considerable commercial work and, whenever the negative size permits, I invariably use it in preference to the big enlarger I bought some time ago.

There's only one construction step that might cause you any trouble. This is the job of cutting the aluminum plates, including the apertures. I licked it with a metal-cutting blade in a power jigsaw. A metal-cutting blade in a coping saw would be a good second choice. The aluminum stock, incidentally, was obtained from a radio-supply house.

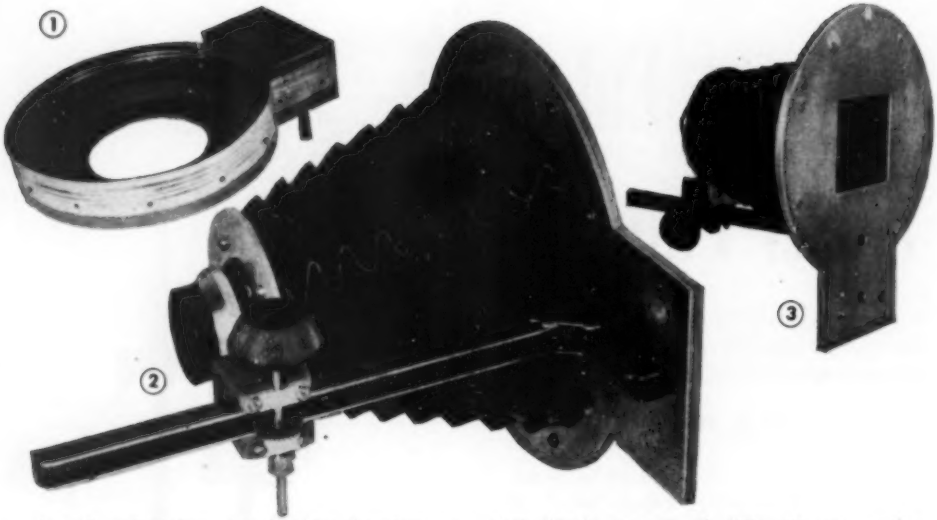
Before you do the aluminum cutting, you'll need to know the end dimensions of the bellows that's to be used. As you'll see in the full-page drawing, the hole in one aluminum plate should be cut to suit the larger end of the bellows. Cement the bellows to the plates at each end and bolt the plates together.

An old camera may yield a serviceable bellows. Otherwise, you can have one made at a reasonable cost.

A ¾″ plywood spacer provides a slot for the negative carrier. The 1/16″ aluminum plate above this slot has a mating member cut from ¾″ plywood. Attach the aluminum with short, flathead screws. Countersink them so they won't interfere with the negative carrier. This aluminum plate supports the condenser unit. Hence, its cut-out should be slightly less than the diameter of the condenser mount.

Another piece of ¾″ plywood goes on top of the ¾″ plywood ring at the rear. On three sides this matches the lower pieces, but the front edge is cut out for the lamp house. The double thickness of ¾″ plywood provides a spot to attach the horizontal arm of the stand.

A band of aluminum linoleum binding 1″ wide around the plywood ring has a threefold purpose. It gives a finished appearance



A rack-and-pinion gives hairline focusing. As seen in Fig. 2, the ½" pinion is mounted in a plastic block, grooved to slide on the channel that carries the rack. Two short screws, with their heads countersunk (Fig. 3), secure the horizontal arm of the channel to the aluminum plates. In Fig. 1, note how the bottom plate provides a ledge to support the condensers.

to the enlarger, keeps the lamp house in place, and acts as a light trap.

To provide ventilation, drill intake vents in the rolled edge of the reflector, both from the inside and outside. Since these are staggered, little light can escape. Also drill holes around the neck of the reflector and in the top of a radio-shield can, held in place by the lamp socket. Blacken the inside of the shield and the part of the reflector it covers, to lessen light flare.

Condenser lenses 3½" in diameter were used. You may be lucky enough to find a pair already mounted. If not, buy separate lenses and mount them in a tube or tin can of the right diameter. Solder in strips of tin-can stock to space them about ¼" apart. A disk of heat-absorbent glass is optional but probably won't be needed.

For a lens I already owned a 3" f/4.5 Wollensak Enlarging Velostigmat Ⓣ in a barrel mount with an iris diaphragm. A similar lens can probably be found by shopping the secondhand counters.

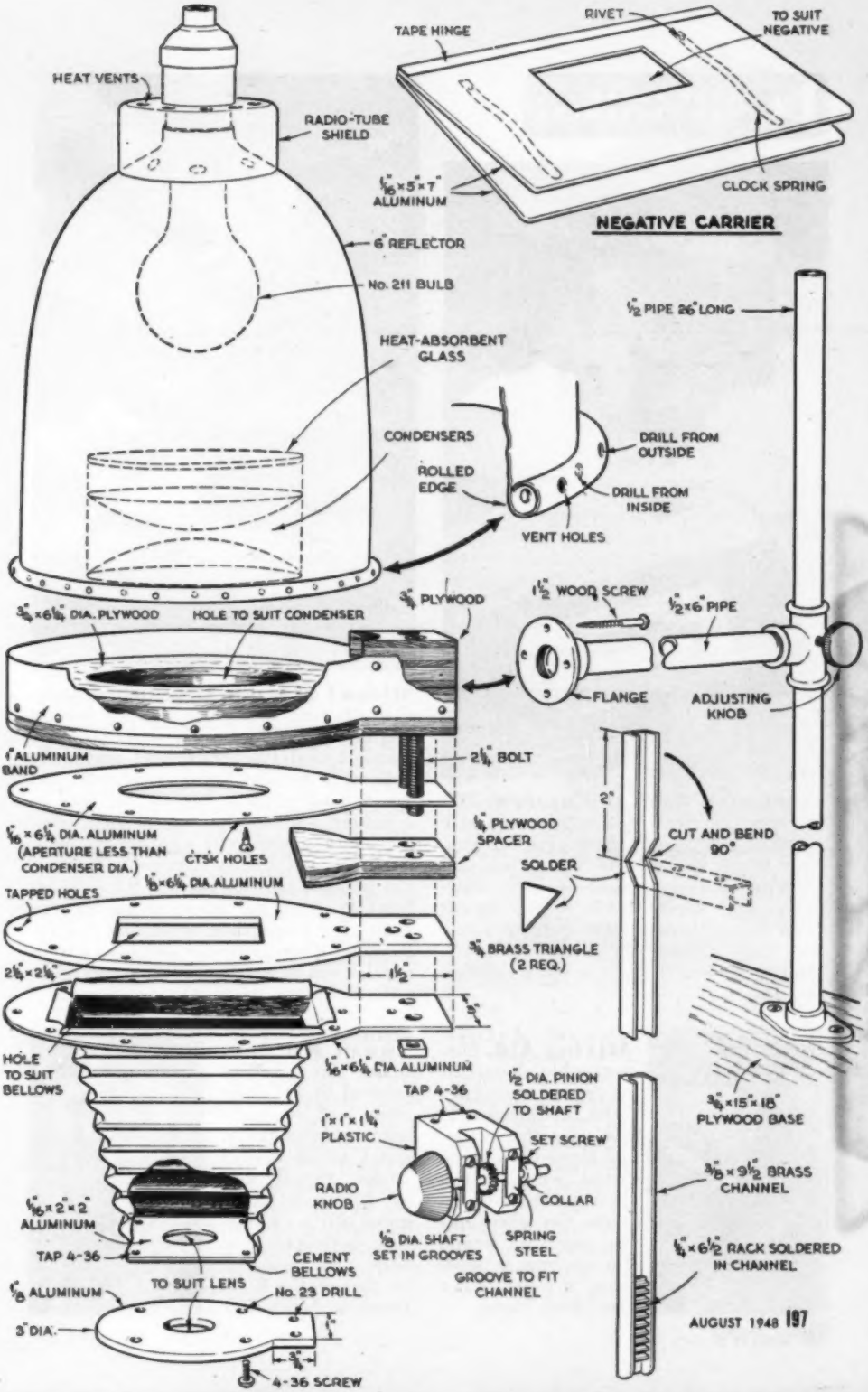
As a starter on the focusing assembly, measure 2" from one end of a 9½" length of ¾" brass channel. At the 2" point, hacksaw out a 45-deg. V-shaped segment from each side of the channel. Then bend the channel exactly 90 deg. and solder on ¾" brass triangles to keep it rigid. The short leg should be drilled for screws.

Sweat-solder a 6½" or 7" length of rack in the channel, being careful to keep solder off the face of the rack. Coat the inside of the channel lightly with solder, apply flux to the rack, set the latter in place, and heat the unit with a torch until the rack seats itself.

Plastic was used for the pinion-mounting block because it gives a smoother sliding action than metal to metal. Two pieces of spring steel retain the pinion shaft. Apply sufficient tension to these to prevent the pinion assembly from rolling down the rack of its own accord. Make a trial assembly before drilling the mating holes in the lens board and plastic block.

In sawing the negative carriers, locate each aperture so that the negative will be properly centered when the back edge of the carrier touches the ¼" plywood spacer. Spring clips, indicated by the dotted lines in the drawing, will automatically keep the carriers snug in the slot.

Ordinary ½" pipe (¾" might be better) is used for the standard. A tee was converted into a slide by filing it out to an easy fit on the standard. Sweat a piece of metal to the side of the tee and drill and tap this extra thickness for a knurled adjusting screw. A weight-and-pulley counterbalance, plus a wall bracket at the top of the pipe to prevent vibration, are worth-while refinements. END


HEAT VENTS
RADIO-TUBE SHIELD
6" REFLECTOR
No. 211 BULB
HEAT-ABSORBENT GLASS
CONDENSERS
TAPE HINGE
RIVET
TO SUIT NEGATIVE
1/16"×5"×7" ALUMINUM
CLOCK SPRING
NEGATIVE CARRIER
1/2" PIPE 26" LONG
DRILL FROM OUTSIDE
ROLLED EDGE
DRILL FROM INSIDE
VENT HOLES
3/4"×6 1/4" DIA. PLYWOOD
HOLE TO SUIT CONDENSER
3/4" PLYWOOD
1 1/2" WOOD SCREW
1/2"×6" PIPE
FLANGE
ADJUSTING KNOB
1" ALUMINUM BAND
2 1/4" BOLT
1/16"×6 1/4" DIA. ALUMINUM (APERTURE LESS THAN CONDENSER DIA.)
CTSK HOLES
1/4" PLYWOOD SPACER
2"
CUT AND BEND 90°
SOLDER
1/8"×6 1/4" DIA. ALUMINUM
TAPPED HOLES
3/4" BRASS TRIANGLE (2 REQ.)
2 1/4"×2 1/4"
1 1/2"
3/4"
HOLE TO SUIT BELLOWS
1/16"×6 1/4" DIA. ALUMINUM
3/4"×15"×18" PLYWOOD BASE
1/2" DIA. PINION SOLDERED TO SHAFT
TAP 4-36
1"×1"×1 1/4" PLASTIC
SET SCREW
RADIO KNOB
COLLAR
3/8"×9 1/2" BRASS CHANNEL
1/16"×2"×2" ALUMINUM
1/8" DIA. SHAFT SET IN GROOVES
SPRING STEEL
TAP 4-36
CEMENT BELLOWS
GROOVE TO FIT CHANNEL
1/4"×6 1/2" RACK SOLDERED IN CHANNEL
1/8" ALUMINUM
TO SUIT LENS
No. 23 DRILL
3" DIA.
4-36 SCREW

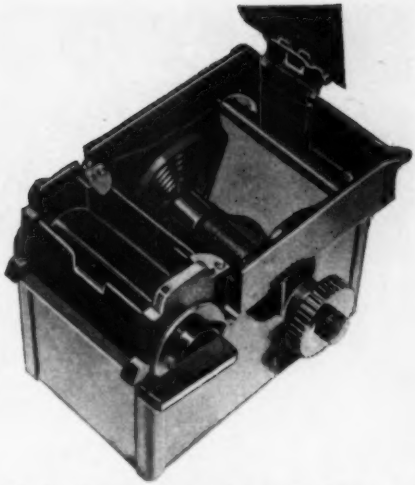
Computer Built in Camera. This new camera, offered by the Eastman Kodak Company, features a built-in exposure computer on the back. It also has a flash synchronizer and an optical eye-level viewfinder. The lens is f/4.5. Shutter speeds range from 1/10 to 1/200 second, plus time and bulb. Named the Kodak Tourist Ⓣ, the new camera is made to sell for $61.50 plus tax.

Slides Cut from Aluminum. Damaged or worn fiber slides for film holders may be replaced by new ones cut from sheet metal. I used .020" thick 24ST aluminum.

Remove the head from the old slides and punch out the rivets. Use one old slide as a pattern for marking out the new ones. Smooth their edges with a flat file and abrasive cloth, and drill the rivet holes. You can use common pins for rivets if the old ones won't do. Polish the slides with fine abrasive cloth. I've found they needn't be painted. However, if you make your slides of a ferrous metal, it will be well to paint or enamel them. *—W. E. Burton, Akron, O.*

Mixing Aid. Photographic chemicals have an annoying habit of sticking to the sides of a graduate above the solution level when being shaken into it. To avoid this when mixing chemicals, form a funnel from a small scrap of paper. Use a hard-finish paper.

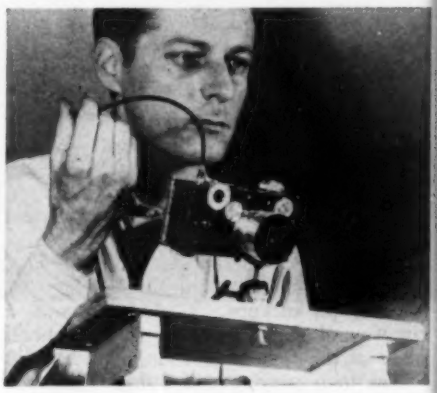
Towel Holder. A film clip tacked or screwed to the darkroom wall or workbench makes a handy, quick-action towel holder. Equally useful is a large paper spring clip or a spring-type clothespin. The latter may be nailed to the wall.—*R. F. Donovan, Jersey City.*



New Tank Loaded in Daylight. No darkroom is necessary with this new tank, the Loadomat 20Ⓣ, offered by Photo Products, Inc., Los Angeles. After a short length of the leader is engaged in the tank's reel, developer is poured in and the cover replaced. By turning a knob, the film then is rolled on the reel. The same knob is used to agitate the film during processing. The tank is made of plastic.

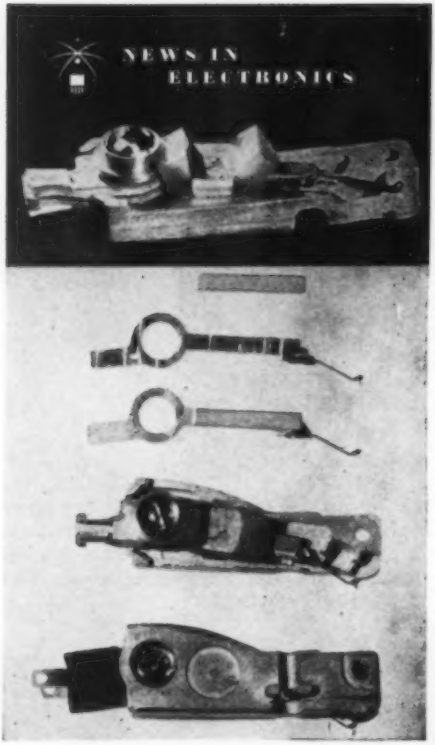
Ladder Makes Tripod. Drilling a ¼" hole in the top step will convert a step-ladder into a sturdy stand for high angle shots. A ¼"-20 bolt with matching nut and a tripod head are the only things you need.

As you see in the photo, the length of the bolt is of little importance. The nut can be tightened to permit just about ¼" of the bolt to project above the step. When the picture-taking session is ended, the bolt is easily removed for normal use of the ladder. With this setup, the weight of the photographer adds to the steadiness of the camera support. Instead of a bolt, a clamp-type tripod fitting may be used.—*William B. Woodington, Philadelphia.*



Print Washing. If the noise of water running into a tray while washing prints annoys you, wrap a large handkerchief around the faucet as shown in the photo. A towel may be substituted for the handkerchief. — *George Wagenhauser. — West New York, N. J.*

Quick Dryer. For hurry-up work, negatives may be dried in 60 seconds by washing them in a saturated solution of potassium carbonate. After one minute, remove the film and drain and wipe away the excess solution. Then polish the negative with a chamois.



Ceramic Made Piezoelectric. A polarization treatment developed by the Sonotone Corporation, Elmsford, N. Y., imparts piezoelectric properties (the ability to convert mechanical pressure into electrical impulses) to titanate, a man-made ceramic. The first application of the substance, which is resistant to heat and moisture, is for phonograph pickups. Top view shows a cutaway of the unit; below it are a small piece of the treated ceramic, a metal strip joined to a playing stylus, and the same strip with the titanate baked on. The complete cartridge is pictured at the bottom. Output and stylus pressure are roughly equivalent to crystal pickups. Frequency is said to cover the entire audible spectrum.

Sprung Pickup Saves Records. Another new pickup cartridge is offered by Webster Electric Company, Racine, Wisc. It features a retractable mounting that automatically lifts the needle whenever pressure of 2.5 oz. or more is exerted. The arm can be dropped or pushed without damage to the needle or record.

Recorder Includes a Radio. This new 18-lb. package that looks like a small suitcase includes a disk recorder as well as a radio-phonograph. A single pick-up arm is used both for recording and play-back. The portable unit is made by Wilcox-Gay Corporation, Charlotte, Mich., and retails for about $90.

Plug Eases Socket Wiring. Stainless-steel pins on the wiring plugs shown at the right will prevent the contacts of miniature tube sockets from being pushed out of alignment or becoming clogged with solder. The plugs, made by Star Expansion Products Company, New York, come in models to fit the 7 and 9-pin miniatures.

Tuning Eye Makes Old Radios Look Up

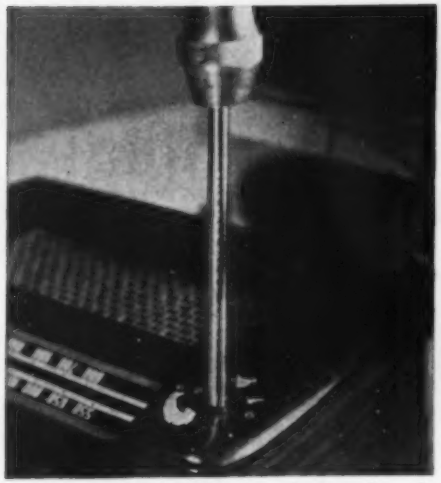
Bring your radio up to date by giving it eye-sharp tuning plus freedom from blasting. Here's how for most receivers.

By William Norton

HARSH background noises that come through when a radio dial isn't properly set won't spoil your listening if you tune by eye. Sounds may fool the ear, but there's no deceiving an electron-ray indicator tube. When the eye squints down to its narrowest angle, you know you're on the beam.

Perhaps you already enjoy the advantages of eye tuning in your living-room console. It's easier than you think to add the same feature to those extra sets in the kitchen, bedroom, and workshop. The two main exceptions are midget TRF receivers and some pre-1930 radios employing triode RF amplifiers. In the former case there is usually not sufficient gain to operate the indicator, while the neutralizing circuits of the latter do not lend themselves to diode detection and AVC. If your radio is not much over ten years old, the chances are that it will be a relatively simple matter to add the eye. On some older sets it will first be necessary to switch over to a diode detector before an eye can be made to operate. This procedure will be described below.

Note the words diode detection and AVC. They are the key to the whole job. Automatic volume control—AVC—consists of a condenser-resistor network connecting the



An opening for the indicator tube is made with an expansive bit. For the 6AL7-GT it should be ¾"; most other tubes need a 1 3/16" hole.

Paint the inside of the opening black to give greatest definition to the tube pattern. The decorative bezel (foreground) goes on last.

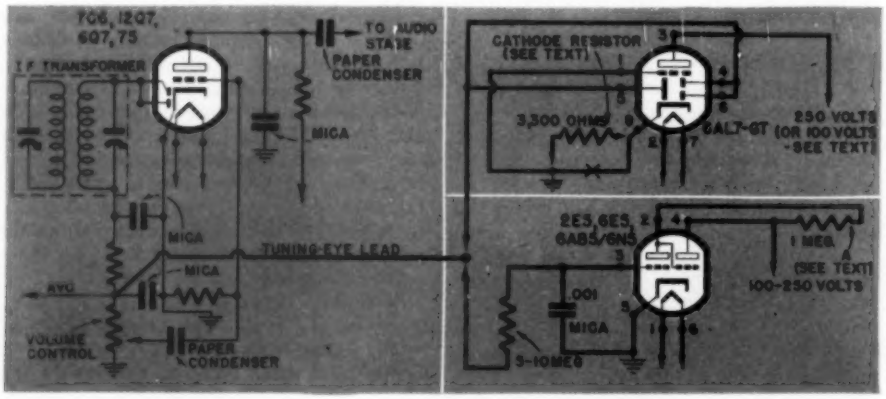
various grid-return leads of each RF or IF stage with the diode detector. The voltage developed across this network controls the deflection of the indicator eye.

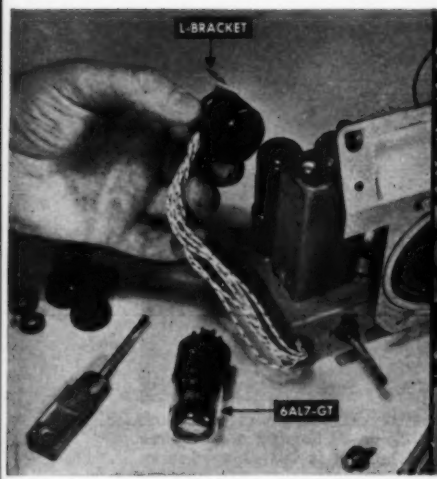
How can you tell whether your set has AVC? Sets that don't have it are usually guilty of "blasting"—a sudden increase in volume as you tune from a weak station to a strong one. The reverse is also true, of course, and you'll be able to tell these older receivers by the fact that they require constant adjustment of the volume. To make doubly sure, tune in a local station and listen for background noise when the station is silent for a moment. Now turn off the station. Sets that *have* AVC generally show an increase in background noise when the pointer is set between stations.

Take a look, also, at the table on page 205. If your detector tube is listed in Col. 1, the set probably has AVC. If you find it in Col. 2 instead, the answer is no.

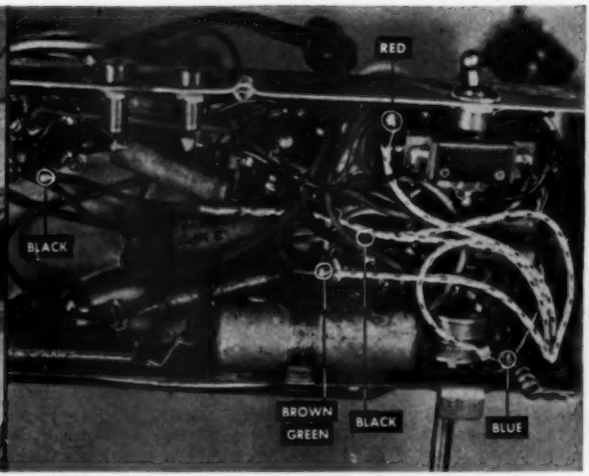
Let's assume for the moment that we're dealing with one of the more modern sets. It may be an AC-DC midget or a straight AC job. If it is a midget, make sure it is also a superhet. It isn't advisable to try the conversion on AC-DC TRF's.

Now find your detector tube in Col. 1 of the table mentioned above and read straight across to the last column to find a suitable indicator tube. For some of these tubes the





An indicator-eye assembly consists of a wired socket and mounting hardware. The L-bracket was used here instead to save cabinet space.



Solder the six leads as shown in the diagrams on the facing page. This 1942 AC-DC superhet already had AVC and diode detection.

recommended plate potential is 250 volts, but they will still glow—less brightly, to be sure—on the 110 volts available from the average AC-DC circuit.

The necessary parts for a tuning-eye assembly are generally sold in kit form. Those marketed by Amphenol ⓣ come with additional information and circuit data. Use the 6-prong MEA6 for a 2E5, 6E5, or 6AB5/6N5; kit MEA8 will be needed for the 8-prong 6AL7-GT.

The new 6AL7-GT can be used wherever the older 6AB5/6N5 is called for. In midget cabinets the smaller size of the new tube may prove a real convenience. Should you wish to use it, the first step will be to remove the socket shield and solder together pins 4, 5, and 6. The reason for this is that the tube was engineered as an FM indicator and the deflection plates must be tied together when it's used on AM. Unlike most other indicators, the 6AL7-GT shows a flat band of light on its translucent screen. The band is at minimum width when a station is tuned in.

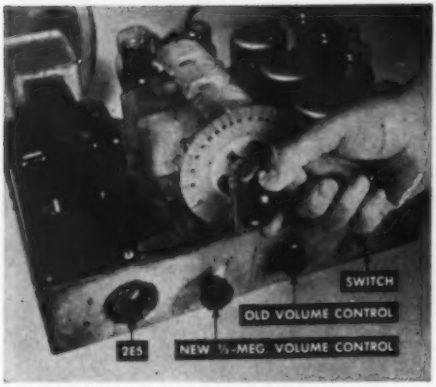
Only six of the eight prongs on the assembly socket are wired, and these may not be the right ones for the 6AL7-GT. If you find this to be the case, remove the extra lead from pin 4 or 5 and solder it to pin 1. Note the color coding of the remaining leads before replacing the socket cover.

Wire the socket into the set as shown at the bottom of page 202. When working on an AC-DC receiver it will be necessary to open the series-filament string at some convenient point and wire the black leads from the tuning-eye socket in series with the others. On an AC set the heaters are put in parallel.

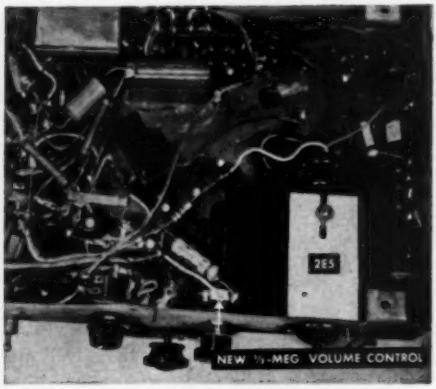
The two schematics shown at the right-hand side of the diagram should apply to most receivers, but it would be well to study your receiver for any possible variation in the AVC circuit. For example, should the eye fail to operate when connected to the hot side of the volume control, it may be necessary to try other points in the detector circuit such as the black or AVC lead of the output IF transformer.

On AC-DC sets you'll need all the voltage you can get, so run the lead from pin 3 to the cathode (usually pin 8) of the rectifier tube. Where higher voltages are available—as on AC sets— this lead may be wired to the output of the power filter. Best place to locate this is at the screen grid (usually pin 4) of the power output tube.

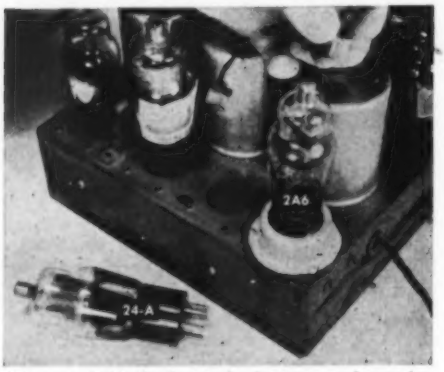
Unless the receiver uses a floating ground, the grid lead of the 6AL7-GT (pin 1) will be connected to the chassis. However, when the chassis is not grounded, make this connection to the cathode of the detector tube. The cathode of the 6AL7-GT (pin 8) will be anchored to the same point if the set has a plate voltage of 125 volts or less—i.e., if it is an AC-DC receiver. For sets of higher voltage, use a 3,300-ohm cathode resistor and



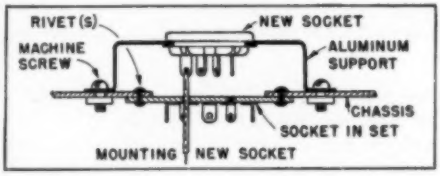
This 1931 model, 2-stage, TRF receiver first had to be altered for AVC and diode detection before a tuning eye could be made to operate.



Bottom view of the converted receiver. Note position of the 2E5 indicator and new volume control. The old control is left at maximum.

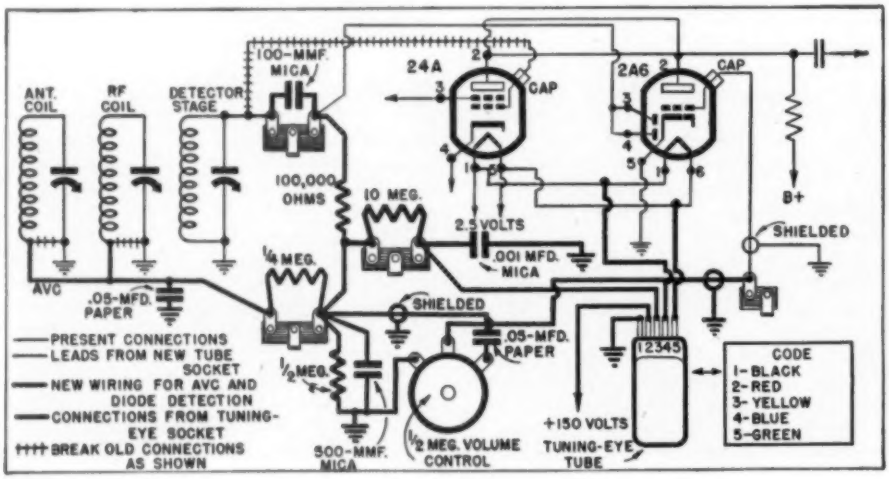


The new 2A6 diode-triode detector replaces the 24A. Its socket goes on top of the old one.



omit the direct connection to ground (the lead marked X in the upper-right diagram on page 202).

Pins 2 and 4 of the 2E5, 6E5, or 6AB5/6N5 must be connected through a 1-meg. resistor (marked A in the lower right-hand diagram, page 202). If you use a kit you may find this resistor already included in the socket.



Fewer than a dozen wired connections are needed to add an eye to a set that has AVC. But what about the other ones? Here the job is slightly more complex, but it is even more worth while in terms of improved performance. Adding a diode detector and tuning eye should reap dividends in improving tone quality as well as ending blasting and off-station tuning.

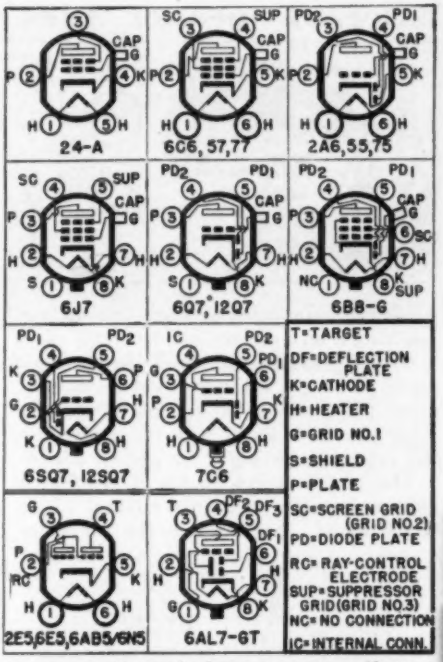
The converted set shown here is an antique (1931), two-stage TRF receiver. It used a 24A for a detector, and this first had to be replaced with a 2A6 diode-triode. A new 6-prong socket was placed on top of the old 5-prong one by means of a flanged aluminum support. Wood or metal spacers about 1″ long could have been used instead. Five wire leads, each 6″ to 8″ long, are soldered to the contacts on the new socket (pins 3 and 4 are joined and require only one lead). These are pushed down through the holes in the old socket and wired into the circuit as shown by the light red lines in the diagram.

Unsolder the clip from the old grid lead and pull the wire through the shielding can to the underside of the chassis. Bolt three or four fiber mounting strips to the chassis to serve as tie points for the new wiring and add the extra resistors, condensers, and volume control as shown. The new grid lead must be shielded; this can be done by using braided wire or by bringing it up through the shield can of the detector coil. Color coding for the tuning-eye socket refers to the MEA6 assembly as used with the 2E5 tube. The grounded lead, 1, is the cathode; 2 is the B-plus lead from prongs 2 and 4 which combines the target, plate, and ray-control electrode; 3 is the grid connection, and 4 and 5 supply current for the heaters.

With three or more shield cans on top of a TRF chassis you may have some trouble

Receivers with these diode detectors probably have AVC	Receivers using these tubes as detectors do not have AVC	Replace tubes in Column 2 with these diodes	Det. tube heater voltage	Det. tube heater current (amps.)	Use for indicator tube
2A6			2.5	0.8	2E5
6Q7			6.3	0.3	6E5
6SQ7			6.3	0.3	6E5
7C6			7.0	0.15	6AB5/6N5*
12Q7			12.6	0.15	6AB5/6N5*
12SQ7			12.6	0.15	6AB5/6N5*
55			2.5	1.0	2E5
75			6.3	0.3	6E5
	24A	2A6	2.5	0.8	2E5
	6C6, 77	6B8	6.3	0.3	6E5
	6J7	6SQ7	6.3	0.3	6E5
	57	2A6	2.5	1.0	2E5

*The new 6AL7-GT can be used in place of the 6AB5/6N5



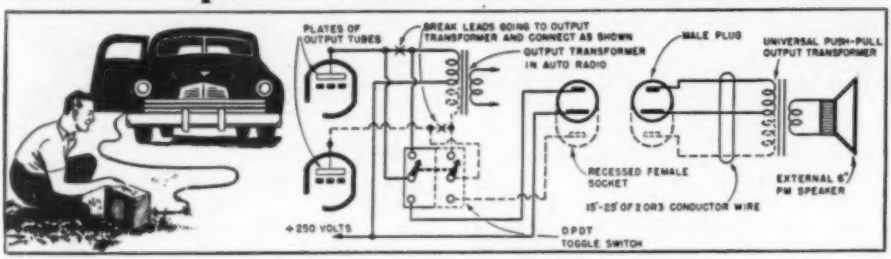
For convenience the base connections (bottom view) of most detector tubes are shown above.

identifying the various coils. The job isn't made any easier by the fact that the same tetrode was often used in the first and second RF stages as well as the detector. This set, for example, had three 24A's.

Some tracing is therefore necessary. Life will be made simpler if you can find a circuit diagram of the set, but it isn't imperative. To find the antenna coil trace the antenna lead-in wire under the chassis. It will probably go—either directly or through a volume control—to one section of a ganged tuning condenser. A wire connects this condenser section to the antenna coil, and this coil is linked to the grid cap of the first RF tube.

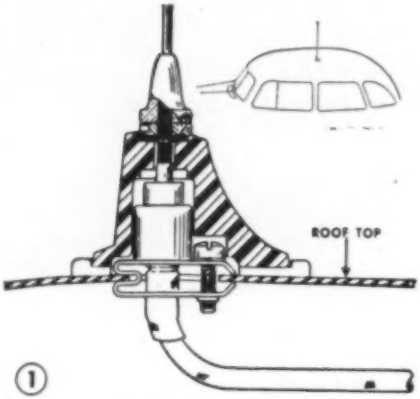
The second section of the ganged tuning condenser will most likely be joined to the second RF tube in the same manner. That leaves only the detector stage to account for. This may be further checked by looking for a fixed resistor and condenser (in parallel) from the cathode of this tube to ground. The detector tube is also coupled through a condenser to the first audio tube, which will in all likelihood be of a different style—type 27 or a similar tube. END

External Speaker Adds Uses to Your Auto Radio



GIVE a loudspeaker enough cord and you can hang it on a nearby limb or simply place it on the ground beside you when you get out of an auto to loll in the shade. For those many times when you are just far enough away from a car for its radio to be of no use, this extension speaker is the perfect answer.

The toggle switch makes it possible to change instantly from the internal to external sound. Just plug in the connector, flick the switch, and carry the boxed speaker anywhere within the 15′ to 25′ range of the extension wire. The solid lines in the diagram show what must be done if the radio has a single output tube; for push-pull output make the changes shown by the broken lines as well. With single-tube output you'll need only a SPDT switch. A two- or three-way polarized plug and socket and two- or three-conductor wire make the connection.



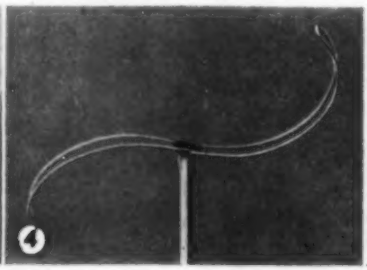
1

2

New Antennas Chase "Ghosts"

TELEVISION and FM frequencies, with their interference problems from terrain or buildings, are bringing a crop of new antennas. A roof antenna for automobile communication systems, made by L. S. Brach Mfg. Corp., Newark, is shown in Fig. 1. It covers the 152 to 162 mc. band. Blanket coverage from 44 to 216 mc.—including old and new FM and all television channels—is claimed by Interstate Mfg. Corp., also of Newark, who make the receptor pictured in Fig. 2. The indoor television antenna (Fig. 3) can be shifted and tuned for clearest reception. Burnett Service Co., New York, sells the unit. The S-shaped, folded dipole (Fig. 4) is nondirectional and serves both FM and television. Technical Appliance Corp., Sherborne, N. Y., is the maker. It also makes the mast, Fig. 5, with separate orientation for high and low-band TV.

3



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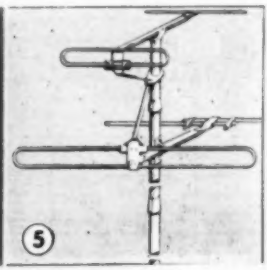

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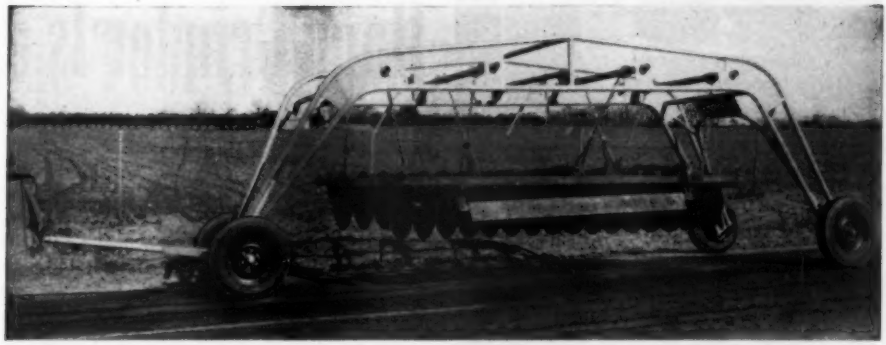
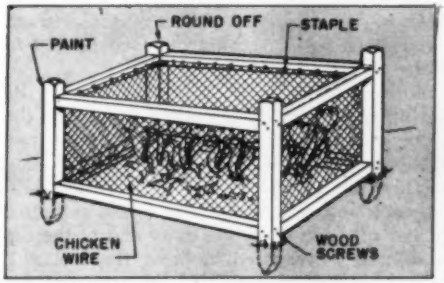


Implement Carrier Is Built Like Truss Bridge

LOOKING like a single-span truss bridge, this carrier transports heavy farm implements across fields and over highways. Four ratchet spools permit one man to lift a two-ton load into riding position. Chains carrying the load are wound over the spools. The unit, built by the Marvin Landplane Company, of Woodland, Calif., is all-welded, weighs 1,400 lb., and rolls on 6.50 by 16 four-ply tires as a trailer.



Wire Frames Protect Flowers

SIMPLE guards to protect flowers and young shrubs may be made from small pieces of lumber and chicken wire. Staple the wire inside the frame and set the legs a few inches in the ground. Paint the frames white.—*Bernard Matzen, Napa, Calif.*

Rake Used with Light Tractor

THIS wheel-less, 390-lb. dump rake has 28 spring-steel teeth that provide a spread of 10′. The implement, designed for use with light tractors equipped with a hydraulic lift and a three-point hookup, is made by the General Corporation, of Dallas, Tex.

Cultivator Uses ¾-hp. Engine

THIS small garden cultivator was built in about 15 hours, using scrap-iron parts and welded construction. The distance between the wheels may be varied from 12″ to 20″, enabling me to run it either between rows or to straddle rows.

For power, I've found a ¾-hp. washing-machine engine satisfactory, though 1¼ hp. might be even better. The clearance beneath the axle is 12¾″. The belt ratio is 1 to 12 and the chain ratio is 1 to 7. A movable idler pulley, controlled from the right handle bar, acts as a clutch. The draw bar may be raised or lowered from a height of 6″ to 3″.—*L. F. Van Der Volgen, Delphi, Ind.*

A rabbet is cut by feeding the work across the table. For such operations, the side fence is down out of the way. When drilling, press the table and work slowly up against the drill.

For clamping the fixture to the workbench, a rigid base like this may be added. Otherwise, just clamp the upright in a vise. Make the table of plywood, the other parts of hardwood.

Hand Grinder Is a

HELD in your hand, a small motor tool is often tough to manage. It takes real practice to make controlled freehand cuts; and the work almost never shows the line-splitting uniformity expected of power tools.

The fixture shown on these pages will put an end to that. It permits accurate work in drilling, rabbeting, routing, shaping, and planing small pieces of wood or plastic. With a couple of simple attachments, it will cut perfect rings and disks.

After completing the upright, shape the lower tool support. Drill the hole slightly undersize. Then sand it until the tool fits. For the top support, cut a hardwood block 1⅝″ by 3″ by 4¾″. Drill it lengthwise for two ¼″ carriage bolts 5″ long, countersinking the heads. Then saw the block apart 1½″ from the other end and rough out a semicircle in each cut edge with a jigsaw. Sand until the tool is a snug fit. Cement felt in the outer jaw.

For accurate work, the grinder must be supported with its centerline parallel to the backboard. To check this, attach the two supports, using wood screws at least 2″ long. Then put the backboard flat on the workbench and rest the grinder in the supports. Saw off or shim up the inner end of the top support as required to bring the tool to a parallel position.

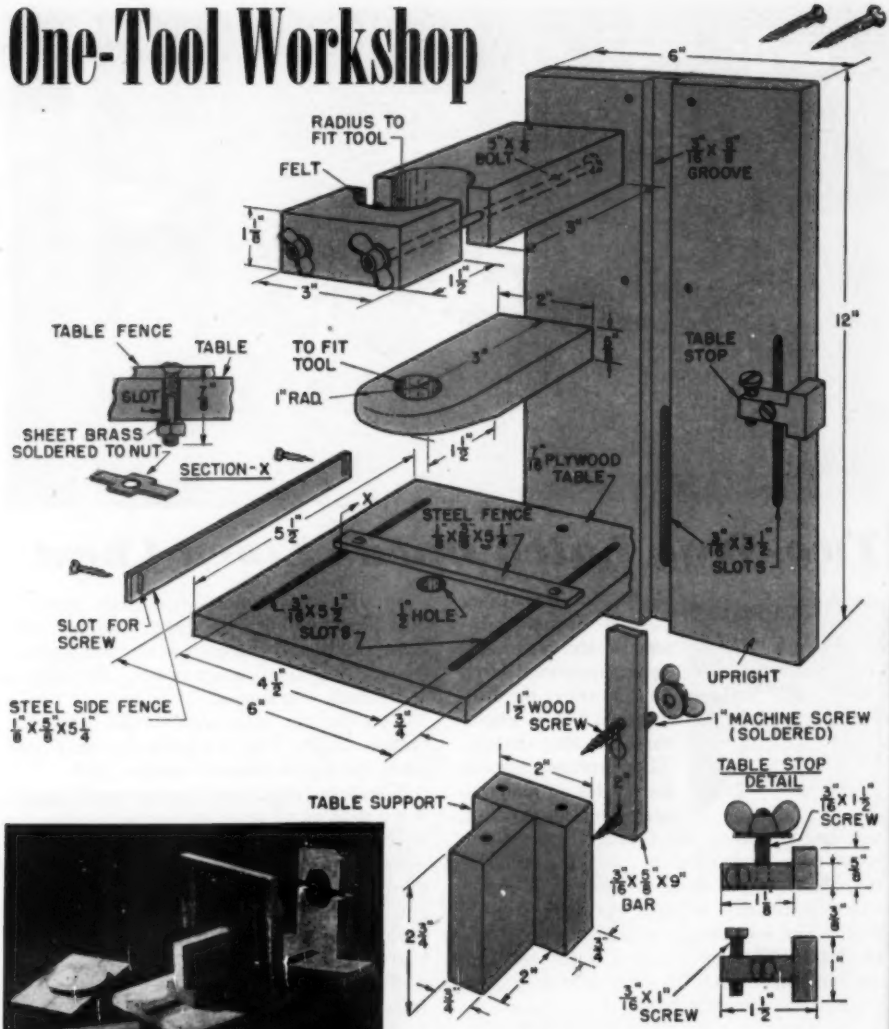
Wood screws hold the slotted side fence to the table. With a screwdriver, you can then raise or lower the fence as desired.

Adjustment of the other fence is made from above, likewise with a screwdriver. Cut two pieces of sheet brass to the shape shown in the drawing. Bend up the long projections and solder one piece to each nut. These keep the nuts from turning.

Drill screw holes in the T-shaped table stop slightly undersize. This will keep the horizontal screw from turning with the wing nut. Lubricate the other so that it can be turned easily with a screwdriver when fine depth adjustments are desired.

When you're ready to operate, raise and clamp the table so the tool just touches the work. Also bring down and clamp the table stop with the screw touching the table. After taking a fine cut, back off the table stop and raise the table again. In this way, make a succession of cuts until the desired depth is

One-Tool Workshop

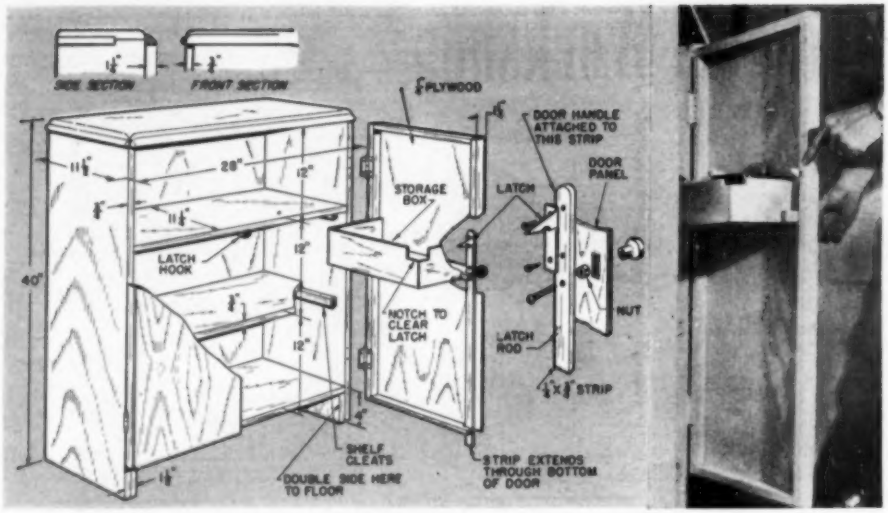


Cut a groove in the upright backboard so the 9" metal bar slides without side play. At the left are three useful attachments—one with clamps for routing and rabbeting and two others for cutting circles.

reached. The same depth can be duplicated in other work by leaving the table stop at its final setting.

Special fixtures will increase the versatility of the device. A piece of ¼" plywood about 3½" by 6" may be fitted with a pivot (say, a wood screw with the head filed off) on which turns a 3" plywood disk. Three phonograph needles protrude from the disk just enough to hold any workpiece pressed on it. This can be used to cut accurate circles with square or shaped edges.

Another plywood panel with two metal fences at 90 deg. will permit concentric cuts on work already round. Still a third fixture can be used as a supplementary rabbeting attachment. This is a plywood rectangle fitted with a fence and miniature hold-down clamps. With work in place, it slides on the main table.—*J. A. Appelquest, Leonia, N. J.*



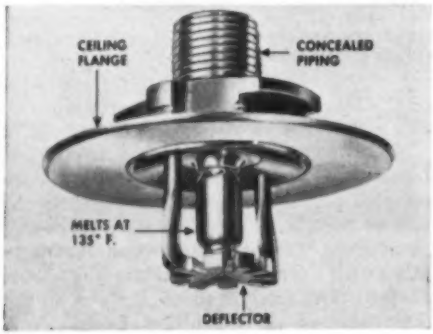
Two-Way Latch Opens Linen Chest

THIS roomy linen cabinet has two unusual features: a hand or foot-operated latch and a storage box built on the inside of one of the doors. The storage box is handy for miscellaneous small articles, whether you keep the cabinet in the bathroom or a bedroom, or even the kitchen. It's built on the door so that it occupies space ordinarily wasted at the top of a shelf. The advantages of being able to trip the latch and open the door with your foot are obvious, especially when you're groping for a towel with wet hands.

Simple construction with butt joints is used throughout. All screws are countersunk and heads covered with composition wood. The sketch gives you the dimensions and details you'll need.

Note that the sides are doubled below the bottom shelf. This supports the shelf and gives the legs a more substantial look.

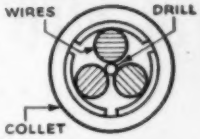
The door latch is extremely simple, being just a strip of plywood sliding in notches cut in the door frame. The catch is cut from a metal corner bracket that can be bought in most dime stores. Both the hand knob and and catch are screwed to the strip of plywood, which extends down through the bottom of the door frame. Sand the cabinet well and finish with paint, enamel, or stain.—*Robert Hoppough, Waukegan, Ill.*



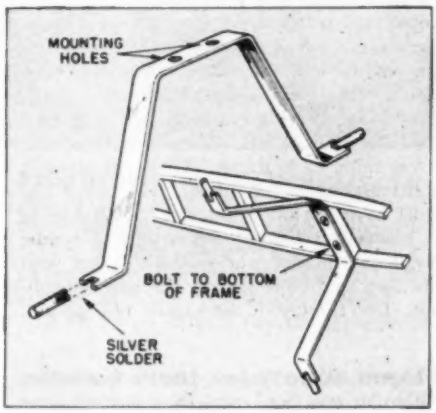
Sprinkler Has Hidden Pipes

A FUSIBLE sprinkler, with pipes concealed in the ceiling, has been introduced by the Grinnell Company, Inc., of Providence, R. I. The automatic sprinkler was especially designed for rooms where the decorative effect would be spoiled by exposed pipes along the ceiling. Only the deflector, its supporting arms, and the narrow ring that covers the opening through the plaster show below the ceiling level. A temperature of 135 deg. F. will start the sprinkler. This is about 30 deg. lower than the rating of many sprinklers.

Drill Held in Collet by Wires



I WANTED to drill some No. 80 holes but couldn't find a chuck that would close on such a small drill. Finally I inserted three pieces of wire in a ⅛" collet and put the drill in the center. By tightening the collet, the drill was held true. You can find the diameter of the wire you need by subtracting the drill radius from the collet radius.—*Robin Williams, Knoxville, Tenn.*

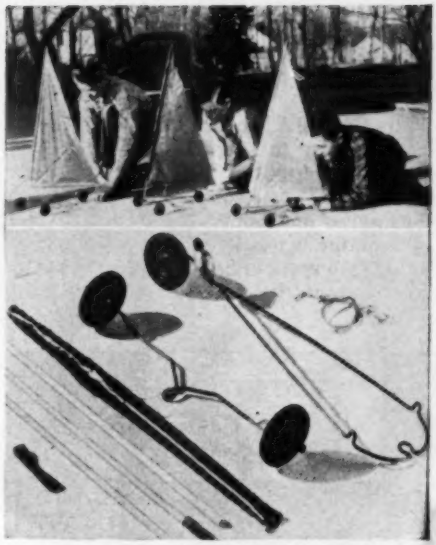


Landing Gear of Spring Steel

SPRING steel from an old phonograph motor or a hacksaw blade makes an ideal landing gear for a gas model plane. I find such a gear absorbs more punishment than the common piano-wire type. Soften the spring by heating, and then shape it. Restore the temper by heating and quenching in oil.—*Freddy Mitchell, Simsboro, La.*

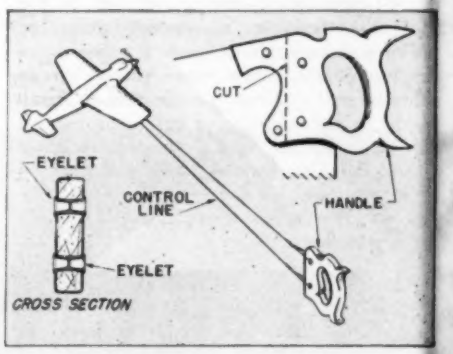
How to Shorten Tiny Screws

HERE'S a neat way to cut off very small machine screws without damaging the thread or heads. Get a piece of scrap metal the same thickness as the desired screw length. Tap and countersink a hole to suit. Drive the screw in all the way, turn the piece over, and file off the projecting part of the shank. Removing the screw takes off any burrs.—*Herbert Pfister, Bronx, N. Y.*



Toy Copied from Sand Sailer

THESE miniature sailers, modeled after the sand sailers raced on southern beaches, are assembled from the kit shown. The toy, which is made principally of plastic, sports a gaily colored sail, smooth-rolling rubber wheels, and a patented nontipping action. Sand Sailers, Inc., of New York City, is the manufacturer.



Plane Control From Saw Grip

A COMFORTABLE control handle for control-line models may be made from a discarded saw handle, or from a replacement handle. Cut off the grip as shown in the drawing. Use four eyelets to bush the holes in the grip and prevent the steel line from cutting into the wood.—*David L. Hyman, Brooklyn, N. Y.*

Tests Show Chemical Fire Hazards

ORDINARILY, an oxygen atmosphere is necessary to keep a fire going. But like most rules, this has its exceptions. When heated, some substances supply their own oxygen and burn without air.

Again, fire is usually thought of as being started by a spark or flame. But certain materials have such low kindling points that just a little heat is sufficient to set them ablaze.

These and other tricks of fire are illustrated in the following experiments. In a chemistry laboratory, hazards of this nature constantly lie in wait for the unwary. So if your hobby is chemistry, better give thought to the possibility of unexpected fire.

Fine Particles Explode. Coal dust, sugar, and starch are seldom thought of as explosives. Yet if divided finely and mixed thoroughly with air, they burn almost as readily as a gas. A dust explosion results.

You can create a harmless dust explosion with the setup at left. Warm the cornstarch a few minutes to dry it. Then put about a half teaspoon in the funnel. The coffee can must have a friction top, not one that locks in place by twisting. Set a lighted candle beside the funnel, put on the top, get your distance, and blow sharply through the tubing. Don't delay or the candle will go out.

Heated Rod Starts Fire. Carbon disulphide has such a low ignition point that a spark or flame isn't necessary to fire it. A heated glass stirring rod will do the trick when brought near enough.

For this experiment, pour a teaspoon of the liquid into a can cover placed on an asbestos mat. (Never handle carbon disulphide in the vicinity of an open flame.) Then heat the end of a glass rod in a candle or gas flame in another room and bring it near the liquid. If the rod is as hot as 250 deg. C., the carbon disulphide will quickly burst into flame.

Flame Separates from Candle. Although we don't usually consider it as such, a candle flame is actually a gas flame. Once a candle is lit, combustion heat liquifies and then vaporizes a little of the wax.

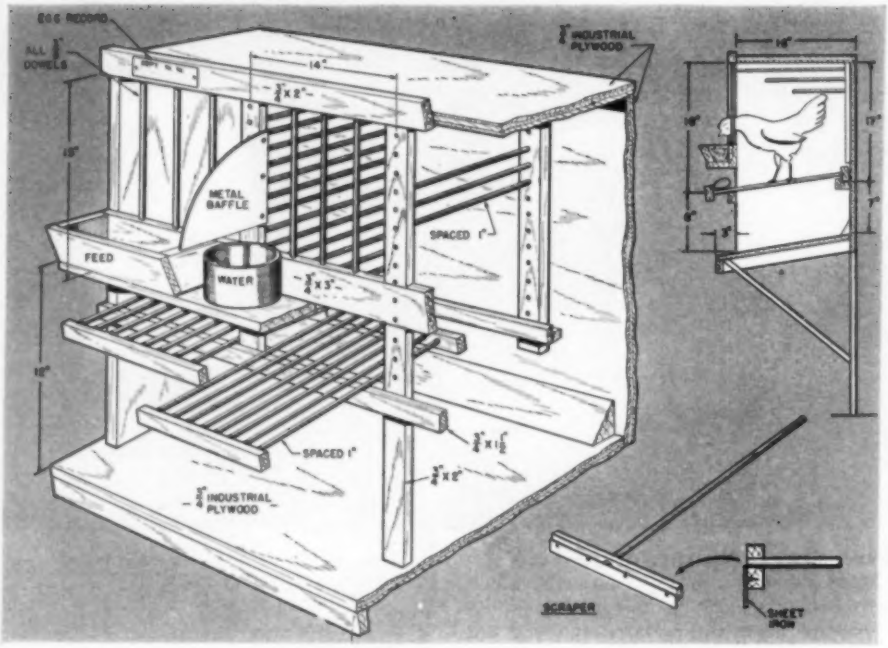
To prove that it's gas, we can cause the flame to burn for a few seconds when detached from the wick. Put a teaspoon of baking soda in a quart jar and add vinegar until the bubbling stops. This generates carbon dioxide gas. Attach a burning candle to a wire as shown and lower it gently into the jar. If carefully done, this will cause the flame to leave the wick.

Fire Starts Spontaneously. Phosphorus has such a low ignition point that it burns spontaneously at room temperature. Hence, it must always be stored and cut under water, handled with tongs, and never allowed to touch your skin or clothing.

With tongs, drop a pea-sized piece into a metal bottle cap floating in lukewarm water. It will catch fire immediately. Cover as shown. Water will rise in the tumbler as the phosphorus unites with oxygen in the air. The white smoke is phosphorus pentoxide, a fine powder. Dissolving in the water, it forms weak phosphoric acid.

Air Isn't Always Needed. Chlorates and nitrates are examples of materials that burn without air. When heated, they supply their own oxygen. Substances of this type are used in explosives, and for safety, you'd better leave them alone.

However, you can have some fun with a little potassium nitrate. You've probably seen "racing sheets" to which you apply a lighted cigarette—and then cheer on your "horse" as it burns and sputters to the finish line. To make such sheets, dissolve all the potassium nitrate you can in a teaspoon of warm water. Then use this as ink to draw invisible irregular lines on uncoated paper. Let dry before using.



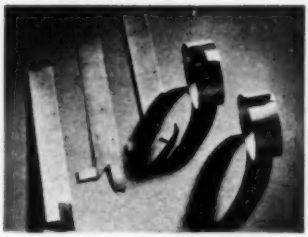
Raise Your Own Eggs on a Shelf

You can raise more than enough eggs for a family of four with this hen house that fits in even the smallest of backyards. That is, if the local ordinances in your neighborhood or town permit keeping chickens.

Although the house is only 7′ long and 16″ wide, it accommodates six hens the year round. My original flock of White Leghorns, shown in the photo, lay more eggs than we can use. The house stands beside the garage during the summer and is moved under cover during the winter months.

The hens stand on a removable, sloping grill. When an egg is laid, it rolls down and out the front. The chickens may be removed by sliding out the grills. However, as long as the hens are fed and watered they do not need exercise for high egg production. Mine never leave the compartments. *—Hi Sibley, Nuevo, Calif.*

Pipe-Insulation Straps Cut from Metal



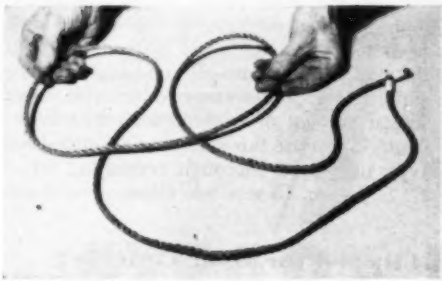
While covering pipe with insulation, I ran out of the conventional bands. I made some straps from thin sheet brass which held just as tightly as the conventional type. Cut strips ¾″ by 9½″. Then slit one end about 1″ as shown at the left of the photo. Next bend the tabs back to make a 90-deg. angle with the strip. Bend the tabs up and over. Push the other end under the tabs, and bend the end back.*—George Gluck, Sheboygan, Wis.*

Jug Hitch Lugs Jug

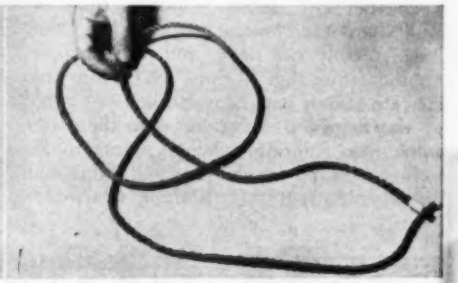
THIS hitch is useful in carrying heavy objects such as carboys, auto batteries, and other containers that have projecting rims but no handles.

If you use a piece of rope such as that shown in the photographs, you'll have to tie the two ends together to form one of the handles. Of course you can splice a rope to form a circle before tying the hitch.

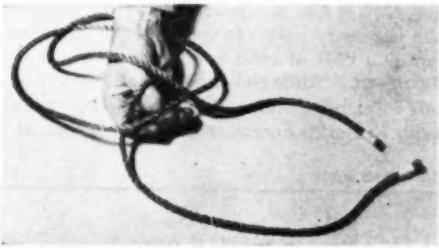
When you have about completed the knot, as shown in the fourth photo, turn it over and drop the opening of the two concentric loops—not the single loop at the left—over the neck of the jug.—*John P. Arnold, Doylestown, Pa.*



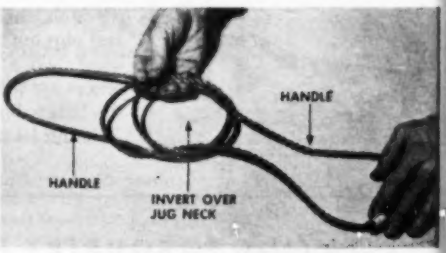
1. To start a jug hitch, use a short piece of rope, forming two loops as shown in this photo.



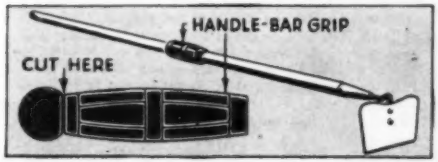
2. Place a portion of one loop over the other. You can place either of the two loops on top.



3. Now put your hand through the center of the crossed loops and grasp center of the rope.



4. Finally, pull this back through the crossed loops and turn knot over onto neck of the jug.



Handle-Bar Grips Help Tools

GARDEN tools fitted with rubber grips, as shown in the drawing, are easier to use and easier on your hands. Make the grips by cutting the ends from standard bicycle or motorcycle handle-bar grips. Cement them in place.—*Don G. Pittwood, Moscow, Id.*

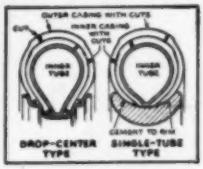
Clothespin Holds Flat Pencil

A SURE-GRIP clip for a flat carpenter's pencil can be made from a spring-type clothespin. Remove half the clothespin and slip the pencil in its place. To make sure the pencil won't slip, cut a notch for the wire as shown in the sketch.—*Munro Hill, Elbridge, N. Y.*

Airplane Dope Used as Dye

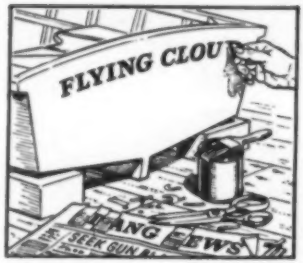
When diluted with its thinner, model-airplane dope can be used as the coloring solution for internally carved plastics. Dope is cheaper and easier to obtain than the usual dyes made for the purpose. The colors "take" readily, are richer and more opaque. Another advantage of dope over dye is that the rate of flow may be controlled somewhat by the degree of dilution. Also there is a more even coloring, whereas dyes are absorbed more by rough spots and chips than by smooth plastic.—*G. Walton, Cincinnati.*

Double Life of Bicycle Tires



Two bicycle tires that have been badly cut can be combined one inside the other to get nearly the full amount of wear from them. One entire tire is used as a liner for the other, as in the above diagram. Place the casings so the cuts on the inner tire are protected by undamaged sections of the outer tire, while cuts on the inner one are protected by good parts of the outer tire.

After the outer tire is worn, reverse the casings. I was surprised at the service I got from two tires that were marred by small but unrepairable cuts. If you have difficulty slipping the double tire over the rim, try a liberal amount of watered soap as a lubricant. If you use this system on a single-tube type tire, do a thorough cementing job.—*H. E. Massa, Greenwich, Ohio.*



Headlines Clipped for Boat Lettering

Literally, my boat is a headliner. While I'm not an expert sign painter, I came up with a very professional looking job of lettering across my craft's stern. All you do is watch the large, page-one headlines in your daily paper, and clip out the necessary letters to spell out the name you want. Then apply a coat of clear spar varnish where the letters are to be placed. While the varnish is still wet, press the letters firmly in place. Follow with another coat of varnish and let it dry.—*Charles Farnsworth, Damariscotta, Me.*

LAYING PARQUETRY FLOORS [WOODWORKING]

Good subflooring, surfaced level and with large cracks filled, is required as a backing for a parquetry floor. The hardwood blocks may be ¼" to 1" thick. They may be obtained made up at the mill in assembled squares or in block sets of pieces cut to size and tongue-and-grooved on ends and sides. Or the squares can be made up on the job and the pieces laid with plain butt joints.

A practical method of laying plain-edged ¾" parquetry is to set the pieces in hot glue, toenailing through the edges of the larger. If there is a border, lay it first; then begin in one corner, assembling a square, and work around the edges, square by square, toward the center. Straight lines will depend on accurate sizing of the blocks. "Running," or a tendency of the squares to vary in size, also may be caused by failure to drive corresponding pieces together with the same force. Corrections can be made by dressing the ends and sides of pieces in the larger squares.

Thick casein glue may be substituted satisfactorily for hot glue, but the latter has the advantage of beginning to hold as soon as it chills.

Thin parquetry is best made up in squares on the bench. Cut the pieces accurately to size, groove all sides and ends, and glue in thin hardwood slip tongues cut with the grain running crosswise. Glue tough-paper or thin canvas backing on the assembled squares, and then glue them to the subfloor. Brads may be used around the edges for blind nailing. Often small finishing nails are driven through the faces, set 1/16", and puttied to match the finish.

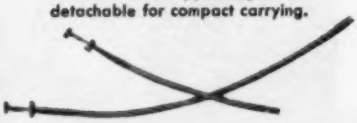
Have on hand a pan of warm water and a cloth to wipe off any squeezed-out glue. Sanding must be done with care because of the changing grain direction. Some final hand sanding with the grain is advisable.

POPULAR SCIENCE MONTHLY SHOP DATA

KODAK TURN-TILT TRIPOD HEAD—permits fast aiming with still and movie cameras. Has multiple-disk felt friction clutches for smooth, easy panning.

KODAK TABLE TOP TRIPOD—makes table-top photography real fun. Elevates camera to convenient level. 8½-inch rubber-tipped legs are detachable for compact carrying.

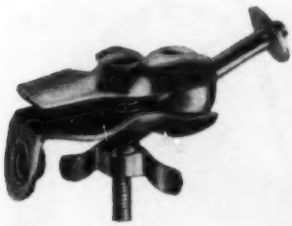
KODAK EYE-LEVEL TRIPOD *(right)* sturdily built to last for years . . . designed for fast set-up. Adjusts from 2 to 5 feet in height. A simple twist locks legs at any extension. Weighs only 2 pounds—folded, it measures 22½ inches. Spur points of the legs give firm surface grip—removable rubber tips included for indoor work.



KODAK METAL CABLE RELEASES—eliminate danger of jarring camera when tripping shutter. 7-inch and 12-inch sizes to fit practically any camera.

STEADY DOES IT

For "on-the-button" shots it's a KODAK TRIPOD OR OTHER KODAK CAMERA SUPPORT. Try one for easy control of your camera—for all-round better pictures. See them all at your Kodak dealer's.



KODAK OPTIPOD *(left)*—its handy felt-lined clamp grips shelf, table, window ledge. Ball-and-socket head holds camera in any desired position.

KODAPOD—substitutes for tripod out-of-doors. Toothed jaws bite into tree, fence, or any other wooden support. The tilt is controlled by thumb screw.

KODAK TILT-A-POD—on your tripod it permits tilting either movie or still camera. Quick-locking screw prevents slipping after adjustment.

EASTMAN KODAK CO.
ROCHESTER 4, N. Y.

"Kodak" is a trade-mark

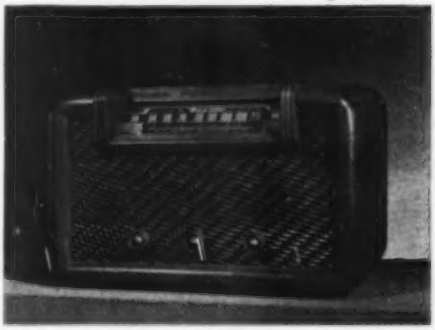
Kodak

Louvers "Light" Room

You can hide unsightly pipes and wiring with a louver-design, false ceiling that can be installed below fluorescent lights. Consisting of transparent plastic louver sections, channels, and fittings, the sections transmit 71 percent of the light, provide uniform illumination. The Benjamin Electric Manufacturing Company, of Des Plaines, Ill., is the manufacturer of the ceiling, which is given the name of Sky-Glo® Light.

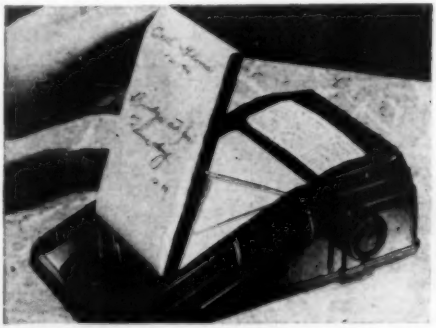
Improved Camera Lens

The Cine-Ektar® 25-mm. lens opens new possibilities of high speed work to the average 16-mm. amateur movie maker. Opening to f/1.4, the Cine-Ektar® is said to offer finer definition and resolution than has yet been possible at such a wide opening. Use of rare-element glasses and ultra-hard lens coatings, according to Eastman Kodak, permits this. Objects only 9½ inches away can be brought to sharp focus.



Better Metal Sheeting

With a process called Rigidizing®, thin metal sheeting emerges not only stronger but handsomer. By redistributing the metal in a sheet, the process increases stiffness and at the same time impresses a design. Patented by Rigid-Tex Corp., of Buffalo, N. Y., the process makes steel stiffer by 88 percent, and aluminum, by 108 percent. The radio above has a rigidized grille.



Pad "Files" Notes

Jot down a note on this desk pad—and it's permanently filed. The knob at the side of the case turns a roller, which feeds paper over the pad and up and around a plate that fits into the writing bed. To get a clean writing surface, the plate is flipped over. A previous notation can be rolled back in sight. The pad is a product of Permanote, Inc., of Philadelphia, Pa.

The '49 Ford

"THE CAR OF THE YEAR"

Designed to set entirely new standards of comfort, performance, economy and beauty in its field, the '49 Ford represents a complete break with the past. Here is a car that is completely new, inside and out. A car that is the triumphant result of thousands upon thousands of man-hours spent in research, design and testing . . . of millions of dollars invested in new facilities, machines and equipment to do the job. From the clean, low lines of its fresh styling to the smallest detail, inside and out, the '49 Ford is truly "the car of the year."

High on the list of important changes is new riding comfort with new independent front wheel suspension, parallel rear springs and Hotchkiss drive. Of equal importance to many are the new engines—100-hp. V-8 and 95-hp. Six, which offer greater economy, improved service accessibility and other features which will mean smoother operation and longer engine life.

The complete line of '49 Fords includes two series: the Custom and the Ford. There are five body styles in the Custom Series—Tudor Sedan, Fordor Sedan, Club Coupe, Convertible Club Coupe, and Station Wagon. In the Ford Series are four models—Tudor Sedan, Fordor Sedan, Club Coupe and Business Coupe. A range of ten body colors is also offered, although all colors will not be available on all models.

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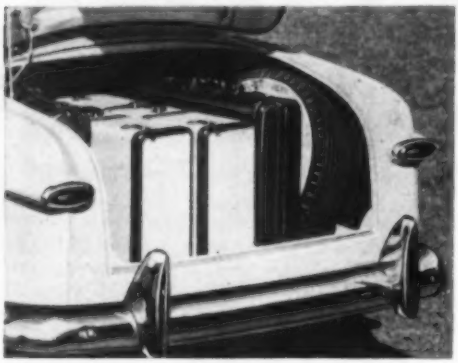
Body Styling. Regardless of body style or series, at first glance the most impressive feature of the '49 Ford is the complete departure from previous exterior design. The body has been made full width, with rear fenders integral with the rear quarter panels. Front fenders are more massive and have higher crowns, giving an almost unbroken line from side to side across the hood. The clean, smoothly-flowing horizontal lines of the body are evidence of the careful attention paid to this design detail. Wind noise and air resistance are reduced and, of course, usable space within the body is greatly increased by the full width design. In the process of achieving



Up to 57% more luggage space.

this smoothness of design a number of the dirt and moisture collecting seams found in conventional designs are eliminated.

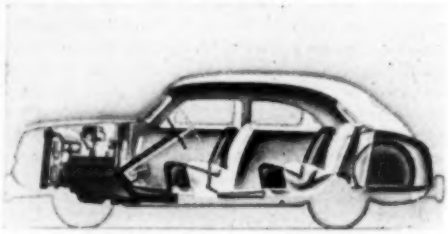
Stainless steel moldings extending horizontally backwards along the sides of the body, do double duty as protective rub-rails. Extra-heavy "Fender Guard" bumpers curl around the sides of the fenders for added protection. On all models the trunk capacity has been markedly increased. Usable trunk volume is 28.5 cubic feet in coupes; sedans have 19 cubic feet, an increase of 57%. The trunk lid is externally hinged and provided with an ornamental handle incorporating the license plate lamp, and license plate holder.

Body construction is likewise completely new, affording greater strength and safety with reduced weight. The combined body and frame structure is actually 59% more rigid. It is of the all-steel, all-welded type, incorporating material and design features that reflect over 21 years of research into the problems of combining maximum strength with minimum weight. The body is bolted firmly to the frame at 22 points, with special shims provided for insulation. Front pillar posts have a narrow cross-section to improve visibility. Another interesting innovation is that the rear wheel housings are completely separated from exterior sheet metal and welded to the rear floor pan. This increases stiffness at the rear portion of body and provides exceptionally solid footings for the full-arch roof rails.

Insulation. Bodies are effectively insulated against heat and noise, a variety of methods being used. Roof, floor and deck-lid panels are lined with a special waffleboard-type insulation. Sprayed-on sound-deadening materials are used for door panels, quarter panels and wheel housings. In addition, the dash is insulated by the use of heavy fabric material.

All structural members in the new Ford bodies are carefully cleaned, treated with a rust inhibitor and painted. This treatment is applied even to the inside surfaces of such large box-section members as the center pillars, in which special openings are provided for the purpose.

"Lounge Car" Interiors of the Ford "Forty-Niner" show every bit as much change as the exterior body lines. Most important advancement is the great increase effected in usable space. This has been accomplished, in part, by moving the engine 5 inches forward. Extending the body sides outward to the full width of the car likewise results in substantially increased seat widths, particularly at the hip and shoulder levels. Front seats are 57" wide, an increase of



White outline—'48 Ford; gray outline—'49 Ford.

6.5", while rear seats now measure 60", or 7¾" more than before. 56" shoulder room has been provided in the front seat and 55" in the rear seat of sedans, enabling three large people to occupy each seat with complete comfort.

Added riding comfort is obtained by scientifically positioning seats well forward between the wheels, resulting in a smooth, soft "Mid Ship" ride. Also new for Ford this year is the seat construction employed – lightweight tubular frame containing a unique "zig-zag" spring base and short, soft-acting coil springs.

Visibility. Another important achievement in body design has been accomplished by Ford engineers in substantially increasing the window area of the new models, while at the same time lowering the overall height of the body over 3". The greater visibility provided for both driver and passengers alike is an important contribution to greater safety of operation, as well as adding to comfort and pleasure. The total vision area in the popular Tudor model, for example,

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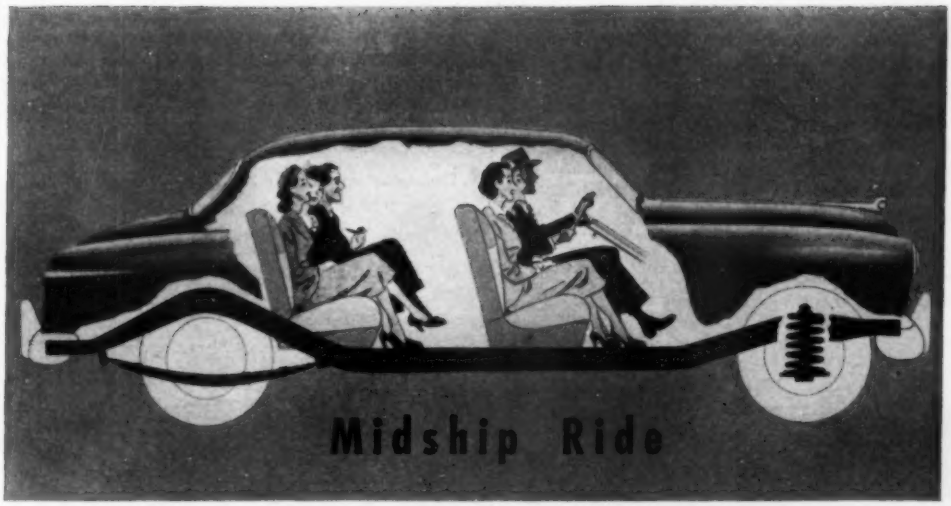

has been increased from 2612 square inches to 2916 square inches. The extra-wide and extra-deep V-type windshield gives over 20% more vision area than before.

Instrument Panel. In keeping with the high quality and luxury feeling of the new Ford interiors, the instrument panel has been completely restyled to combine beauty and utility. Oil pressure gauge, fuel gauge and battery charging and engine temperature indicators have been grouped in a single cluster around the rim of the 100 mph. speedometer directly in front of the driver. The speedometer face also contains the headlight beam indicator light, and provision for turn signal indicators. A completely non-glare lighting system is employed to illuminate the gauges and speedometer. Based on the "black light" system developed during the war for illumination of aircraft control panels, the Ford system uses a light that approximates ultra-violet and is invisible to the human eye. Instrument figures, graduations and pointers are coated with a substance that emits a clear glow when acted upon by the "black light" rays, thus becoming easily readable in the dark with no distracting bright light or reflections.

Custom models have a clock in the center of the instrument panel and locking glove compartment at the far right. Provision is made for the installation of a radio below the clock, with speaker grille located at the top of the panel next to the windshield. Tests show that this high-level speaker placement gives greatly improved acoustical reception for all passengers.

Controls. The popular dash-mounted starter button has been retained. The windshield wiper control has been placed within easy reach on the instrument panel, along with a three-position light switch, three-position ignition switch and lock, choke control, and on the Custom models, an automatic cigar lighter. An ash tray is also provided in the panel. Operating controls and their placement follow standard practice, a two-spoke steering wheel being used to provide unobstructed vision of the gauges and speedometer cluster. A T-handle pull-type parking brake control is used in place of the pistol-grip type.

Two upholstery choices will be available in the Custom series—blue-gray tweed broadcloth and a gray-green striped mohair. In the Ford series, green striped broadcloth or green and red striped mohair is offered. Both series may be had tailored in tan leather, at extra cost. The convertible model comes in either red leather combined with beige bedford cord, tan leather with beige bedford cord, or green leather with green bedford cord, depending on the exterior body color selected. Station Wagons have genuine leather upholstery on driver's seat and vinyl is used on passenger seats.

Door controls have been extensively modified to give greater ease of operation and safety. Outside door handles operate by pulling outward. Inside door handles pull up to open, thus eliminating the possibility of accidentally opening a door by leaning on the handle. Also, possibility of snagging clothing is minimized by placing open ends of handles towards front of car. Door lock inside controls are push buttons which return to open position whenever the door is opened or closed. It is thus impossible to lock the keys in the car. Ignition key operates

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exterior door locks located in both front doors. Either right or left door may be opened with the key, regardless of which one was locked from the outside originally.

Appointments. Ford models are provided with a variety of interior appointments, including arm rests at each side of both front and rear seats in sedans and club coupes, an ash tray in both front and rear compartments, coat hooks, interior light and sun visor. The Custom models are equipped in even greater detail, with extra quality upholstery and floor mats, cigar lighter, robe and assist cords, clock, dual sliding-type sun visors, two ash trays in rear compartment and two interior lights.

maintain nearly constant temperature inside the car regardless of outside temperature. Thermostat is set by a push-pull knob on dash. All the way out permits maximum flow through the coil, and all the way in shuts off flow completely, permitting blower to be used in hot weather for forced circulation of fresh, low-humidity air.

Defroster operates in conjunction with heater. A push-pull knob on dash regulates dampers inside the heating coil box, directing warm air to the windshield. When defroster knob is pulled out to its "full out" position, full discharge from the powerful blower flows through the defroster ducts to remove heavy ice from windshield quickly on the coldest day.

Instruments are grouped directly in front of driver, and "black lighted".

A Living Room on Wheels—that's the overall impression created by Ford's new combination of increased visibility, greater usable interior roominess, extra-wide seats and smartly styled materials and fittings. This comparison is further heightened by Ford's new ventilating system, which admits fresh air through screened openings next to the radiator and discharges the air into the car body just above the toe boards. Each inlet is individually controlled by knobs on the steering column bracket. The forward movement of the car produces a ram effect in the air intake, delivering fresh air under pressure. This pressurized ventilation permits vent windows to be opened slightly even in rainy weather to maintain air circulation.

The three-way "Magic Air" heating system (available at extra cost) is designed to operate in conjunction with this new ventilating system. A two-speed blower takes air from the right-hand air intake and passes it through a heating coil. The warmed air then enters the car body through an outlet that extends across the dash above the toe board. A three-way valve permits operation of the system as either (1) a fresh-air heater with forced circulation for cold weather or quick warm-up; (2) a fresh-air heater without blower for milder weather; (3) with intake closed, as a recirculating heater for quick heating in very cold weather or to keep out obnoxious fumes in heavy traffic.

A thermostatically-controlled valve regulates flow of hot water through the heating coil to

Two New Engines: For the "car of the year" Ford provides a choice of two engines—a new V-8 and a new Six. The following are the basic engine specifications:

	SIX	V-8
Type	L-head	L-head, 90° "V"
Displacement, cu. in.	225.9	239.4
Bore x Stroke, in.	3.3 x 4.4	3-3/16 x 3-3/4
Max. brake hp. @ rpm.	95 @ 3300	100 @ 3600
SAE—AMA hp.	26.1	32.5
Compression ratio	6.8 to 1	6.8 to 1

Both V-8 and Six cylinder engines incorporate many radical changes in design and construction which decrease power losses, increase engine efficiency, provide exceptional accessibility for servicing and assure longer engine life. The major changes incorporated in both engines include: a new "Equa-Flo" cooling system with balanced type thermostat and pressure type radiator cap; greatly improved lubrication system; new combustion chamber contours; redesigned intake manifolding; unique vacuum differential spark advance regulation; new single breaker-type distributor mounted for easy accessibility; more effective crankcase ventilation; timing mark on pulley or damper at front of engine and a carefully engineered 3-point rubber mounting system.

The new V-8 engine has an off-center location of oil passage in each crank pin, providing a "sludge pocket" designed to trap foreign matter carried over from main bearings. Individual steel-backed precision-type bearings are locked in the end of each connecting rod replacing the single floating type formerly used for each pair

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of rods. V-8 valves are precision set and periodic adjustment is not required. Valves are straight stemmed and guides are one-piece type for better heat transfer and more effective lubrication. Heat and wear resistant valve seat inserts are used at both intake and exhaust valves.

Seats are "sofa wide" and trimly upholstered in modern fabrics.

The Ford 6-cylinder engine block has been increased in height and connecting rods have been made longer with consequent decrease in side-wall thrust. Larger main and connecting rod bearings are provided. Cylinder walls are lubricated by pressure spray from a drilled hole in lower end of each connecting rod. An extra-quiet rotor type oil pump is gear driven from center of camshaft. Another innovation is provision for installing a base-mounted oil filter (at extra cost) connected directly to the engine lubrication system by drilled holes, thus eliminating all external oil lines. Valve mechanism on the Six is completely new with high-lift cams, pressed-in valve guides, and self-locking, adjustable tappets. Either the modern viscous type or the efficient new rubber type vibration damper is bolted to front end of crankshaft.

Savings in gasoline mileage of up to 10% have been achieved. The major factors responsible for this increased economy are: (1) the completely new body design with greatly reduced air resistance; (2) the new cooling system which permits higher engine operating temperature with consequent decrease in heat loss to coolant and a decrease in internal friction resulting from higher lubricant temperature; (3) improved manifolding with more even distribution to each cylinder; (4) new combustion chamber contours permitting high (6.8 to 1) compression without detonation even when using non-premium fuels.

Lubricating oil is forced under full pressure to camshaft, crankshaft, main and connecting rod lower bearings through passages in engine block, in both V-8 and Six. On the V-8, timing and distributor drive gears are lubricated by an intermittent pressure spray while cylinder walls, pistons, pins, valve mechanism and oil pump drive gears are lubricated by throw off from the bearings. Cylinder walls, pistons, and pins on the Six receive oil under pressure from a drilled hole in lower end of each connecting rod while timing gears, distributor and oil pump drive gears are lubricated by throw off from bearings.

The new "Equa-Flo" cooling system gives an equal flow of coolant throughout every part of the system. The high-capacity water pumps

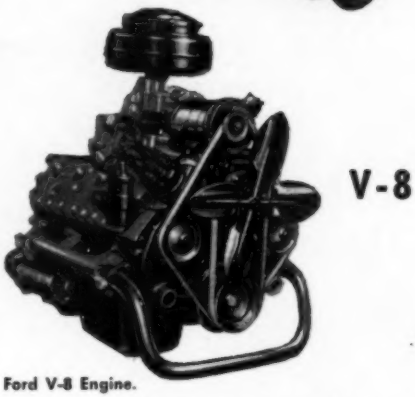
(two on V-8, one on Six) force all coolant directly to rear of block, thence up into head and back to radiator. Turbulence is high as a result of the high velocity, improving heat transfer. Uniform temperatures are maintained with no possibility of hot spots. No special provision is required for valve seat cooling. A pressure-type radiator cap is used on the flat tube and fin-type radiator, permitting a maximum pressure of about 4½ pounds in the cooling system with a correspondingly higher, more efficient coolant temperature. Loss of coolant is practically eliminated by use of the pressure type cap. New balanced type thermostats, which are not affected by water pressure, are used on both engines for quick warm-up and a recirculating by-pass at each pump assures uniform temperatures during warm-up period.

Fuel pump on both engines operates at higher pressure, reducing possibility of vapor lock. On the V-8, pump is in center and at rear of block away from the hot exhaust manifolds. A special shield is provided on the Six to protect fuel pump from heat given off by manifold.

The generator is rated at 30 amperes at 7 volts and is air cooled. A three-way regulator maintains constant voltage, limits current output and prevents battery discharge through the generator. Ignition wiring is provided with heavy synthetic sheathing that is highly resistant to moisture, oil and ozone.

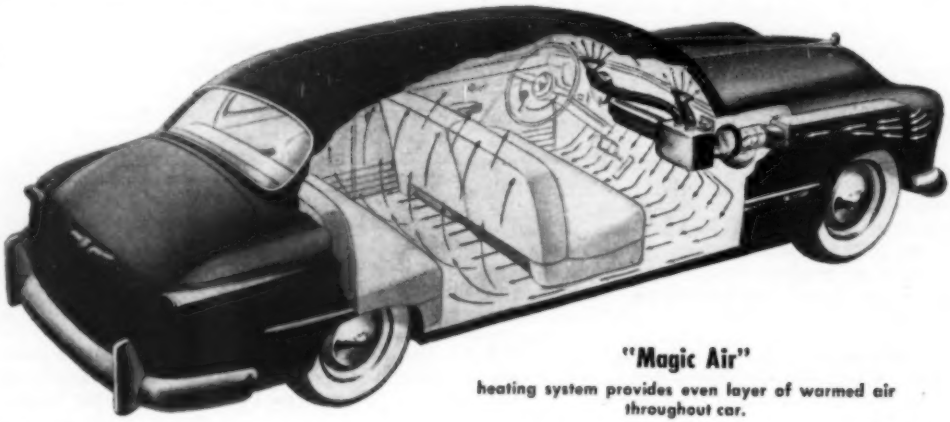
Economical Service. The new Ford engines are designed for quick, economical inspection and service. Engine accessories are positioned well above the center plane of the engine where they can be reached easily. The distributor is near the top of engine, and ignition wires are held in place by rubber grommets. A timing mark is provided at front of engine where it can be seen clearly. For quick, easy servicing of bearings, oil pump intake screen, etc., oil pan removal has been made as simple as possible on both engines. This careful and thorough attention to engine design, permitting easy maintenance, will be an important '49 Ford feature for both owners and mechanics.

Ford Six Engine.



Ford V-8 Engine.

Road lighting is provided by sealed beam headlights which can be readily adjusted both horizontally and vertically. Twin parking lamps are located in the radiator grille and dual combination tail- and stop-lights blend into the rear contour of the car. Provision is made for install-



"Magic Air"

heating system provides even layer of warmed air throughout car.

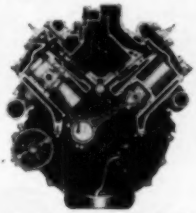
advertisement

ing directional signal indicators in the parking and taillights. The license plate is illuminated by a light in the trunk lid handle.

New Suspension. Of great interest to automobile enthusiasts is the fact that, with the introduction of the "Forty-Niner," the transverse spring suspension that has long been almost a Ford trade-mark has been done away with. The new Fords for '49 have a completely new suspension system, using "Para-Flex" rear springs and "Hydra-Coil" front springs. Both elements of the system have been carefully engineered to work in complete harmony with each other, for a balanced, cushioned ride.

The "Para-Flex" rear springs are, as the name implies, semi-elliptic leaf springs mounted parallel to the frame. Impregnated inserts between tips of spring leaves, together with concentrated pressure-type rubber bushings at shackles and brackets, make lubrication unnecessary. Rear shock absorbers are hydraulic double-acting aircraft type.

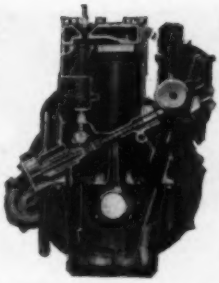
The "Hydra-Coil" front springs have double-acting hydraulic aircraft-type shock absorbers mounted inside them. This method permits the shock absorbers to be readily removed and replaced, without even jacking up the wheels, and the springs protect them from flying stones, etc.



Cross section view of the new 100 h.p. Ford V-8 engine.

Swinging link independent front wheel suspension is employed to permit either wheel to move up or down without effect on the other. A new, one-piece, rubber-mounted stabilizing bar across the front assists in controlling side sway of the car on curves and turns.

Frame. Serving as the backbone of these new Fords is a completely new double-drop frame, with big box-section side rails 4 inches deep and 3¾ inches wide. Two heavy gauge channel sections are welded together at their flanges to form the box-section, which extends from front suspension cross member to center of kick-up at rear axle. Weld is continuous throughout the box-section. Five cross members are used, with an exceptionally large box-section front suspension member. Frames for the Convertible and Station Wagon models are further reinforced to compensate for the inherent loss of body rigidity in the former and the normally heavier loads to be expected in the latter.



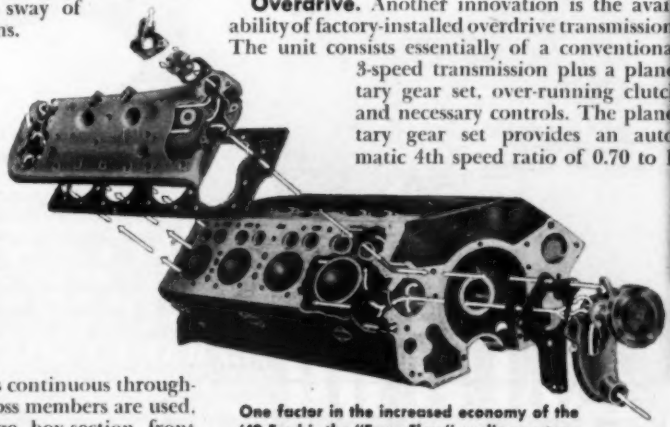
The new Ford Six engine develops 95 h.p.

Another chassis change for '49 is the adoption of Hotchkiss drive in place of the former torque tube and radius rod system. In this new system all driving and braking forces are transmitted through the rear springs, giving smoother, more comfortable starts and stops, and reducing unsprung weight.

Axle Ratios. A further development is the use of a new semi-floating rear axle, with hypoid ring gear and pinion carried in an extra-strong, light-weight banjo housing. Hypoid design, together with the forward location of the rear seat, practically eliminates drive line tunnel in rear compartment floor. Single row, ball type wheel bearings are permanently lubricated. Rear axle ratio, standard, is 3.73 to 1; with overdrive, 4.10 to 1. An optional ratio of 4.10 to 1 is designed for use in the mountains. The heavier Station Wagon model has a 3.91 to 1 axle ratio as standard and 4.27 to 1 with overdrive.

The transmission of the '49 Ford is of conventional 3-speed type, with shift lever mounted on the steering column. Quiet, long-life helical gears are used in all speeds. Transmission ratios are as follows: 1st, 2.819; 2nd, 1.604; 3rd, direct; reverse, 3.625.

Overdrive. Another innovation is the availability of factory-installed overdrive transmission. The unit consists essentially of a conventional 3-speed transmission plus a planetary gear set, over-running clutch and necessary controls. The planetary gear set provides an automatic 4th speed ratio of 0.70 to 1.



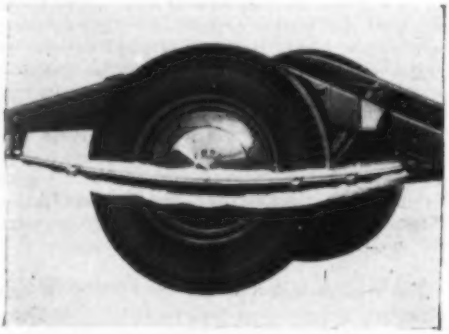
One factor in the increased economy of the '49 Ford is the "Equa-Flow" cooling system.

Shift into overdrive gear is made at any time after car reaches a speed of about 27 mph. by simply releasing accelerator pedal for an instant. Car remains in overdrive until speed drops below about 21 mph. at which speed the drive reverts to regular 3rd gear. Driver may shift from overdrive back to 3rd gear at any time by depressing accelerator past wide open throttle position. This operates a "kick-down" switch that permits transmission to shift back to regular 3rd speed automatically, to provide for faster acceleration in passing other vehicles or for better hill-climbing ability.

Hydraulic brakes are "King-Size", operate with easy feather-light pedal pressure.

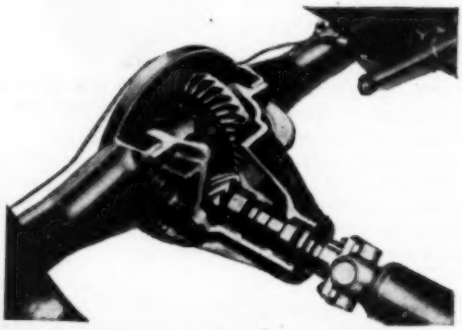
The rear axle ratio on cars equipped with the new overdrive is 4.10 to 1, in place of standard 3.73 to 1. With overdrive in operation, engine speed is 23% lower than in a car with standard axle and no overdrive. The result is smoother, quieter operation, longer engine life and a marked increase in fuel economy. The 4.10 to 1 axle provides exceptional performance for acceleration and hill climbing.

New "King-Size" hydraulic brakes with "Magic Action" touch have been developed for both series. These utilize the energy of the car's momentum to aid in applying the brakes, thus decreasing the pedal pressure required for a given deceleration rate as much as 35%. Brake area of 177 square inches is an indication of the ample margin of safety provided for a car of this size and weight.

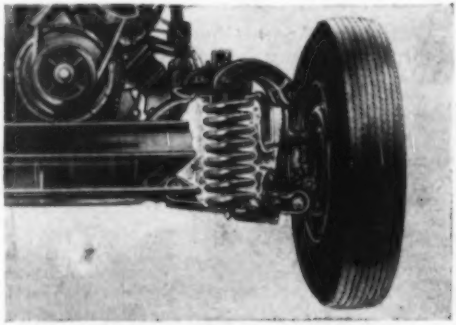


"Para-Flex" Rear Springs are made extra long, extra strong for smoother riding.

Tires. On all models except the Station Wagon 6.00 x 16 4-ply tires on wheels with 4½-inch rims are standard equipment and the new super balloon 6.70 x 15 4-ply tires on 5-inch rim wheels are available at slight extra cost. Station Wagons are equipped with 7.10 x 16 6-ply super balloon-type tires on 5-inch rim wheels as standard equipment.



Cut-away view of new Ford axle and differential showing hypoid design.



New "Hydra-Coil" Front Springs use soft-acting coils for the spring suspension.

From road to roof, from bumper to bumper, Ford for '49 makes good the promise of being the one and only *new* car in its field. And to drive one is to *know* that here is "the car of the year" —the '49 Ford.

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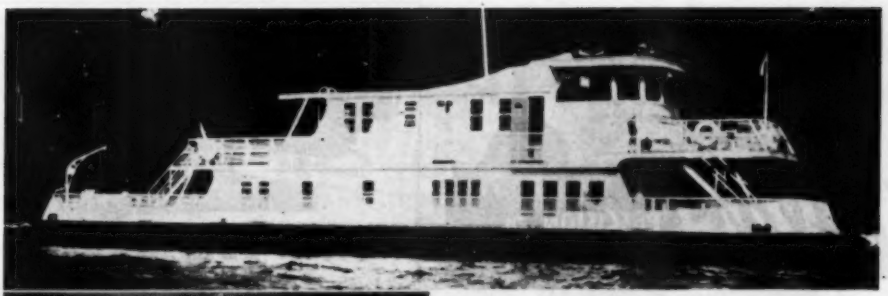
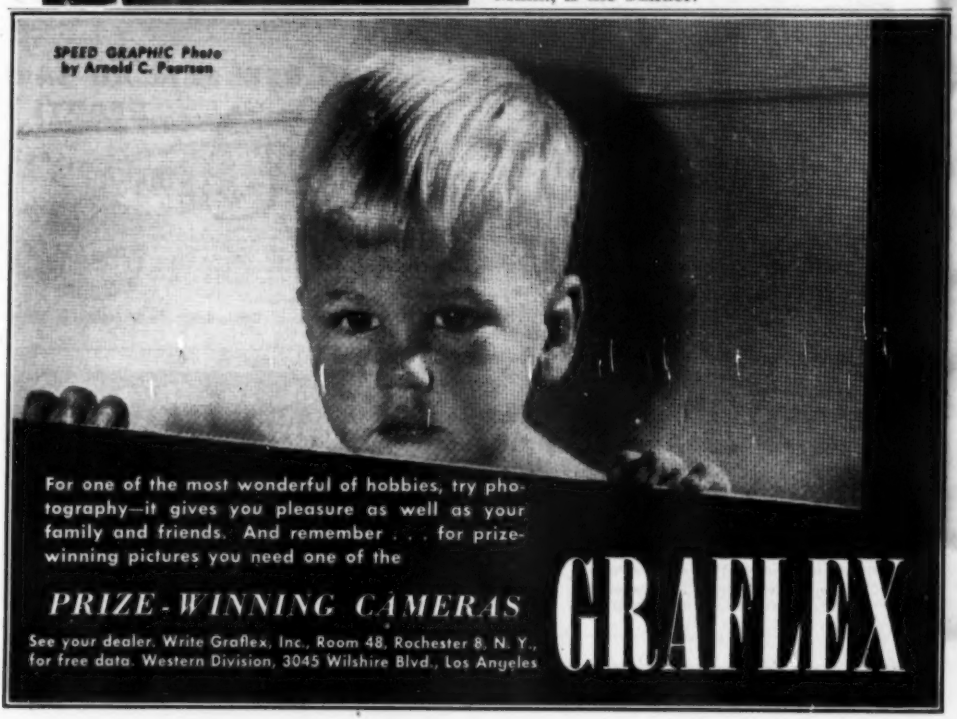
FORD MOTOR COMPANY



Houseboat Propels Itself

Did you ever want to float down the river like Huck Finn on his raft? Well, now you can do it and take all the comforts of home in this DoALL Houseboat Cruiser ⓣ. And when you want to go upstream, the vessel's two 165-hp. Diesel engines can take you 1,000 miles, at 8½ miles an hour, without refueling. With an over-all length of 100 feet and a 23-foot beam, the 168-ton vessel sleeps 10, plus crew and servants. It even has a full-sized tile bath, a wood-burning fireplace and an internal telephone system. Continental Machines of Savage, Minn., is the builder.



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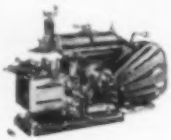

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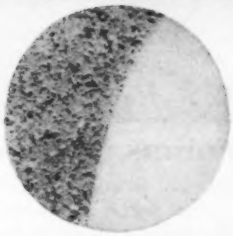

A small section of the surface of an average car magnified 20 times. The left side is shown still covered with Traffic Film. The right side has been cleaned with Du Pont NO. 7 POLISH.

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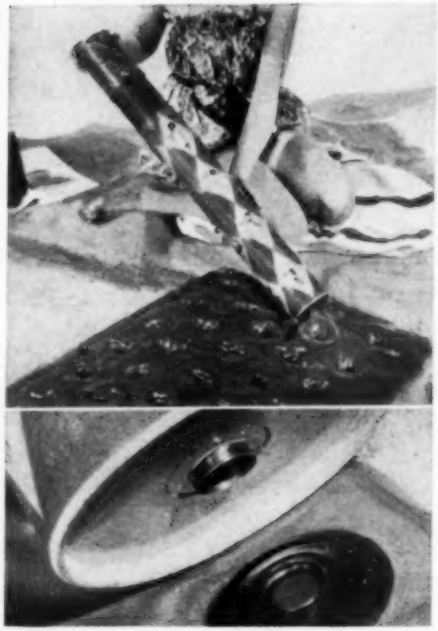

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THESE portable, battery-operated floodlamps light up automatically in an emergency. Plugged into any standard outlet, they switch themselves on when regular power fails, and off again when it is resumed. Available in 15- and 25-pound sizes, the units have a voltmeter for checking battery strength, and an indicator bulb that burns when the lamps are on. They are made by Chisholm Mfg. Co., of Boston, for public halls, hospitals and factories.

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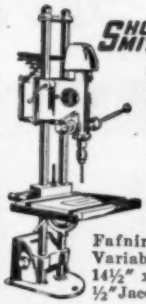
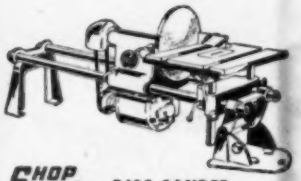
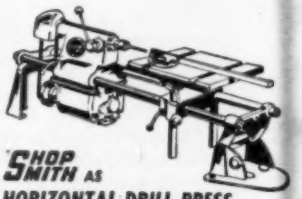


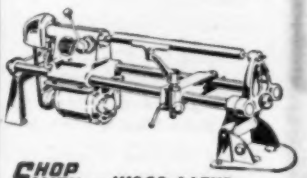
SHOP SMITH AS VERTICAL DRILL PRESS Capacity: Drills to center of 15" circle. Clearance: Table to chuck—27" max. Spindle: ⅝" Dia., 6 spline, hardened tip. Spindle Feed: 4¼". 4 grease-sealed Fafnir ball bearings. Variable speeds. Table: 14½" x 17". *Equipment:* ½" Jacobs key chuck. Fence.



SHOP SMITH AS DISC SANDER Disc Diameter: 12". Table Dimensions: 14½" x 17". Tilting Table. *Equipment:* 12" disc. Mitre gauge.



SHOP SMITH AS HORIZONTAL DRILL PRESS Only *SHOPSMITH* performs this highly useful function. No limit to length of work. Provides accurate method of drilling for doweling, etc.



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We are interested in complete information about Speed Sweep brushes and Arbitrin sweeping fluid.

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PRESSURE QUEEN

Outperforms them all

The only portable spray painting outfit having 4 cylinders in space usually required for one. Paints buildings; refinishes automobiles; inflates tires; lubricates chassis and farm machinery. Does more work in an hour than hand brushing in a day. Uniform pressure without pulsation. Ideal for home, farm, service station, machine shop and contracting painter. Factory tested and guaranteed.

● If your dealer does not sell Pressure Queen, order direct for immediate shipment.

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151 RAILROAD AVE. HARRISON, OHIO

ASSEMBLE YOUR OWN CAMERA

SAVE UP TO 4/5TH RETAIL COST!
It's Fun, It's Economical

Embossed Leatherette Masonite finish. Kit complete with all parts; lense, shutter, screws, glue and complete simple instructions.

Model FP101 Film Pack Camera 2¼x3¼ $2.98
plus 80c Excise Tax and Postage

Model RF220 Super Roll Film, Size 120 $3.98
plus 20c Excise Tax and Postage

See your local dealer, or order direct. Check or Money Order. No C.O.D.'s. Dealer Inquiries Invited. Reg. Discounts.

CAM-KITS, INC., Dept. PS Carlsbad, N. Mex.

HOLD-E-ZEE

AUTOMATIC GRIP SCREWDRIVERS

MORE WORK IN LESS TIME!

UPSON BROS., INC., 86 Exchange St., Rochester 4, N.Y.

Hold-E-Zees do the job better, faster. They excel wherever screwdrivers are used. Gripper instantly released by spring action, sliding up out of way when not in use. All materials highest quality.

AT LEADING DEALERS EVERYWHERE

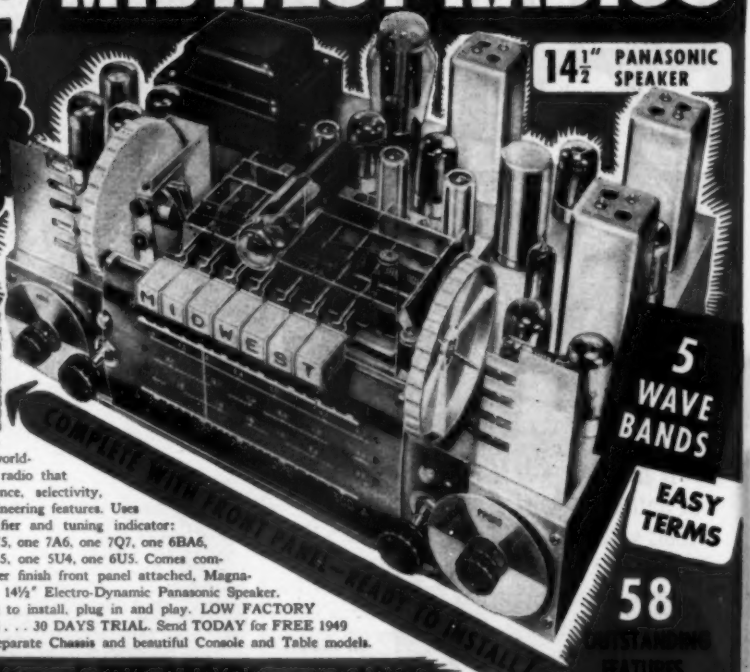
LOW FACTORY PRICES!

...on the Sensationally NEW 1949

MIDWEST RADIOS

NEW SERIES 16 SUPER DE LUXE AM-FM CHASSIS

30 DAYS TRIAL



14½" PANASONIC SPEAKER

5 WAVE BANDS

EASY TERMS

58 OUTSTANDING FEATURES

Including the Exclusive Midwest

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TELEVISION Audio Switch-Over

FIDEL-A-STAT Color-Ray Tone Selection

TRI-MAGNADYNE Coil System

...Plus NO-DRIFT FM and many other features

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A Complete Line of FINE RADIOS and RADIO-PHONOGRAPHS . . . Available in SEPARATE CHASSIS Like the POWERFUL SERIES 16 AM-FM Model above or in COMPLETE CONSOLES like this

Beautiful SYMPHONY GRAND

AM-FM Radio-Phonograph with TELEVISION Audio Switch-Over and NEW Intermix AUTOMATIC RECORD CHANGER

A Magnificent musical instrument and a masterpiece of cabinet design—the finest Midwest Radio in 29 years of manufacture. Offers world-ranging radio reception and newest automatic Intermix Record Changing Phonograph. Uses Series 16 Super DeLuxe AM-FM Chassis. Giant 14½" Panasonic Speaker; Tri-Magnadyne Coil System; Built-In Loop Antenna. Other luxurious console and table model cabinets available with Series 16, 12, and 8 chassis—on Easy Terms and 30 Days Free Trial.

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Cool air drawn through the patented* Carburetor keeps the bottom of the bowl dry, so there is never a "wet heel". Bowl is treated with honey, so no "breaking-in" is required. A pipe that beginners can enjoy without having to accustom themselves to it. Ask for Carburetor Yello-Bole at dealers, $2.50. Kaufmann Bros. & Bondy, Inc., Estab. 1851, 630 Fifth Avenue, New York 20.

*U. S. PAT. NO. 2,082,108

This picture of Honey Girl is displayed wherever Yello-Boles are sold.

Identify Yello-Bole pipes by the honey-seal in the bowl. It keeps the honey fresh.

Tally Board with Light

EYESTRAIN is eliminated when workers in poorly lighted areas use this tally board with lamp attached. Its lighting assembly has a three-volt bulb and three standard flashlight cells, assuring long battery life. Designed for heavy duty, the entire unit weighs only 24 ounces. The manufacturer is Clyne Mfg. Co., of Cincinnati, O.

Carbon Won't Curl

FEWER sheets of carbon paper are wasted by a typist if she uses a new, moisture-resistant type of tissue that will not curl. This is accomplished by applying a coating of Vinylite Ⓣ plastic to the back of each sheet. In addition, the new carbon paper is said to be less likely to tear in handling.

IT'S NEW! HERE'S YOUR RIFLE, SON

It's a he-man shootin' .22 with more new features than you ever saw in a popular priced rifle. You'll go for the new "Red Devil" sight; the "Redi-Feed" drop-in loading platform, streamlined bolt, self-cocking and side thumb-safety features.

H&R Arms Co.

"Pioneer" 765

PRICE $13.50

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This rifle is newly designed and streamlined throughout for fast, safe, accurate shooting. It's full size, for the fullest measure of shooting pleasure. No other rifle at this price has all the new features of "Pioneer" 765.

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MOTO-TOOL ★ THE "POCKET-SIZE" MACHINE SHOP

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Approx. 27,000 R.P.M.

A TESTED TOOL THAT PACKS YEARS OF PLEASURE

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10 Reasons Why Moto-Tool's a Better Buy

Oil-less, sealed bearings ● Patented automatic chuck lock pin ● Oversize armature shaft; hardened, ground, polished ● 110 Volt, AC-DC motor ● Sliding snap-type switch ● Handy hanger hook; cord protector ● Shock-proof bakelite housing ● Dust-filtered air-cooling system ● Dynamically balanced for vibrationless operation ● Weighs only 13 oz.

PRE-WAR PRICES STILL PREVAIL

Moto-Tool Kit No. 2, with 23 accessories (high speed steel cutters, grinding wheels, polishing accessories) and heavy-duty professional Model 2 Moto-Tool in natural-finish, hardwood case **$23.50** (Items purchased separately would cost about $30.00; you save $6.50.)

Moto-Tool No. 2, with one emery point **$16.50**

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MONEY-BACK GUARANTEE

Buy Dremel Moto-Tools from your dealer. If he cannot supply you, order direct from the factory on 10 day trial, money-back guarantee. Shipped postpaid for payment in full (send check or money order); or send only $2., we will ship C.O.D. You pay postman balance plus postage. Catalog of Moto-Tools and Accessories FREE.

DREMEL MFG. CO.
Dept. 128-H Racine, Wisconsin

New DREMEL DRILL PRESS

ONLY **$9.95**
(Less Moto-Tool)

Here's a portable, precision drill press at an amazingly low price. Just the thing for creating costume jewelry, model making, wood carving, routing, etc. Utilizes Model No. 2 Moto-Tool, which can be raised or lowered, swung in any direction, or quickly removed for off-hand use. Drill Press stands 12" high. Base is 6¾" x 4". Weighs approximately 3½ pounds.

For nifty, thrifty shaves...

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STROPS—CLEANS WITHOUT REMOVING BLADE

RAZOR, STROP AND 5 VALET BLADES $1.25

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GOOD WEAR FOR WORK GOOD LOOKS FOR PLAY

REEVES Army Twill is a double duty fabric that's right for work and play. It's highly resistant to wear and tear, and its wide variety of vat dyed colors are fast to sun, water and perspiration. Being Sanforized*, it can take repeated washings and still come up fresh and new. For better looks and longer wear—demand Reeves Army Twill.

**Residual shrinkage less than 1%*

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DIXIE-WESTERN
DUAL INTAKE MANIFOLDS for V-8 FORDS AND MERCURYS

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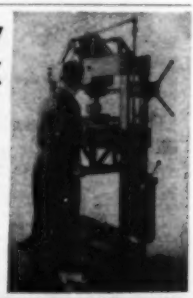
Describes all manner of Production and Shop Work on KRW Hydraulic and Bench Type Arbor Presses. 32 pages illustrating the new KRW Hand-operated, Electric-operated and Air-operated Hydraulic Presses. *Write for your copy today.*



K. R. WILSON, DEPT. 54, 215 MAIN ST., BUFFALO 3, N. Y.

Twice-Told Tips

Browsing through back numbers is a favorite pastime of many POPULAR SCIENCE *readers, and they have found many new uses for old ideas. Here are some old standbys that haven't deteriorated with age.*

Electric Tester Quickly 'Candles' Eggs

Jan. 1922 Eggs are not always what they seem. An inspection of the shell gives no idea of the condition of the yolk. Here is an egg tester that will reveal the hidden inner truth. Make a cardboard funnel with the small end just large enough to take the bulb end of an electric flashlight. Close the large end of the funnel with a cardboard disk in which there is a hole just large enough to cradle the egg nicely. White cardboard, which will reflect the light, should be used for the egg holder. When an egg is put in place, it can be quickly "candled" merely by flashing on the light.

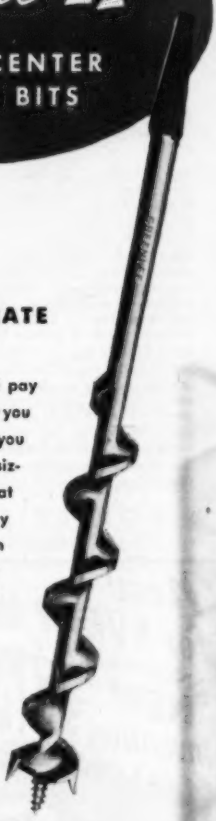
• • •

Dusty Gray Finish for Oak

Sept. 1927 A gray antique-looking finish can be given to oak by covering the wood with two coats of a 5-percent solution of silver nitrate, followed by a solution of hydrochloric acid. Set it aside to dry in a dark place, then neutralize the acid with a coat of ammonia. This should

Greenlee 22

SOLID-CENTER AUGER BITS



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GREENLEE 22 is a name it will pay you well to remember whenever you buy Auger Bits. For it assures you sharp cutting edges, accurate sizing, bright, high finish, and that smooth, easy action so necessary in fine craftsmanship. You can be certain, too, that every GREENLEE 22 Solid-Center Auger Bit is "factory sharp" when it reaches you. For each is "Plastic-Sealed" with a special protective coating to keep it in perfect condition for you. To buy top quality, buy GREENLEE.

TOOLS FOR CRAFTSMEN

GREENLEE

SPECIAL OFFER . . . ONLY 10¢ FOR HANDY WOODWORKING CALCULATOR

Quick solutions to countless woodworking problems. Just set dial: convert linear feet to board feet; compare characteristics and workability of various woods. Also shows bit sizes; nail specifications; tool sharpening hints; etc. Heavily varnished cardboard, 6" diameter. Send 10c to Greenlee Tool Co., 2128 Columbia Avenue, Rockford, Illinois, U. S. A.

BUILD YOUR OWN 2500 WATT ELECTRIC LIGHT PLANT

All you need is an electric generator; a small engine to drive generator at proper speed; 2 dual sheaves; 2 V-belts; and a welded angle iron base. No wiring is involved, and you do not need to know anything about electricity to make this assembly.

Start out by buying the 2.5 KVA Leland Alternator shown above. It is a 120 volt, 60 cycle, single phase, A.C. generator, complete with radio filter box, and self regulating voltage. It must turn at 1800 r.p.m. for bright, even lighting. Requires 3¾ H.P. to turn generator at full load—so buy an engine of at least 6 H.P. to have plenty of reserve.

We will ship you the GENERATOR ONLY, without pulley or belts, for $125.00 freight prepaid. If your needs are urgent, we will assemble your set, using above generator and a 6 H.P. Salsbury gasoline engine, manually started, governor controlled, and ship to you $297.00 freight prepaid. Same unit but with Ensign conversion to run on natural gas $347.50 freight prepaid.

To eliminate time lapse for personal checks to clear, we suggest remittance by bank draft or cashiers check.

HOPFER & COMPANY
3122 EAST 14TH STREET, OAKLAND, CALIFORNIA

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"NEW Invention" Electroplates by BRUSH

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Pneumatic Air Tools

SAVE $64.00 AND UP

Ideal fender and bumping hammers, and for riveting brake lining, concrete breaking and many other uses. Like new. At these unheard of low prices it pays to order a good supply.

CHICAGO PNEUMATIC RIVETER & CHIPPING HAMMER

CP9X offset handle, with air control. Takes up to ¼" rivet, weight 8 lbs. List Price $79.00. Special Price **$10.95**

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Chicago pneumatic CP4 with air control, push button throttle, takes up to 3/16 rivet. Weight 6 lbs. List Price $73.00— Special Price..... **$8.95**

Model CP3X—takes 5/32" rivet, wt. 5 lbs..... **$7.95**

PRICES F.O.B. CHICAGO. Immediate delivery. SOLD ON MONEY BACK GUARANTEE. Send check or money order.

C & M EQUIPMENT COMPANY 1831 S. State St., Dept. B-8, Chicago 16, Ill.

For QUICK Advancement Learn WOOD PRODUCTION ENGINEERING

For quick advancement learn Furniture Drafting and Engineering. You can master these subjects in a short time, either through Home Study or by coming to Grand Rapids. Write Today for Free information. State interest, whether correspondence course . . . or residence course . . . Also state if veteran.

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WRITE NOW FOR FREE CATALOG NO. S-023

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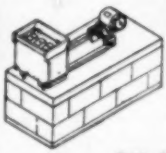
POWER TOOLS

FOSTER MFG. CO., 1 KINSEY AVE., BUFFALO 17, N. Y.



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CONCRETE BLOCK MACHINE

Sell blocks; or build your home, garage, barn at ⅓ cost by making and laying your own blocks.

This simple machine which you can build yourself at a cost of about $15 (excluding motor) will make a block in 30 seconds using only one form. 2 to 4 forms can be used on each vibrator.

Power driven concrete mixer plans also. Send dime for details and "How to Make and Lay Blocks."

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INCLUDED: Eye Glass Case, Wiper, Eye Glass Cleaner with each order! **30-DAY TRIAL OFFER. NEWEST STYLES. POSITIVE MONEY-BACK GUARANTEE.** Write today for **FREE** Catalog, Low Prices, Scientific Sight Test Chart!

Broken Lenses Replaced — 48-Hr. Service.

LOW AS $1.95 AND UP

LEE EYE GLASSES CO., Dept. Q-10
4148 Easton - St. Louis 13, Mo. SEND NO MONEY

Save Money-Make Money with LARSON Leathercraft

For gifts or for sale—make easy to assemble leather items. Complete stock leathers, tools, accessories. Send ten cents for new catalog of 101 money making ideas.

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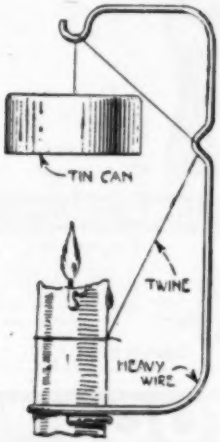
be applied out of doors, since the fumes are very powerful. Do not touch the work with your fingers during the process, for the marks may show. Finish with well-rubbed coats of paste floor wax.

A gray finish like the one that results from this treatment is now being used on oak pieces of modern design.

• • •



A Simple and Automatic Candle-Extinguisher

Apr. 1921 A simple arrangement to make a candle extinguish itself within a given time is shown. A support of stout wire is twisted around the candle, bent in a semicircle a little more than half-way up, and ended in a loop. A small can is cut to act as an extinguisher. A piece of thin twine is pushed through the center of the can and tied with a knot. The thread is carried over the hook in the support and through the curved part, and finally is tied around the candle. Roughly, an average candle will burn half an inch an hour. To have the candle extinguished in an hour simply tie the twine half an inch below the top of the candle. When the wax has been burned away to this point, down comes the extinguisher.

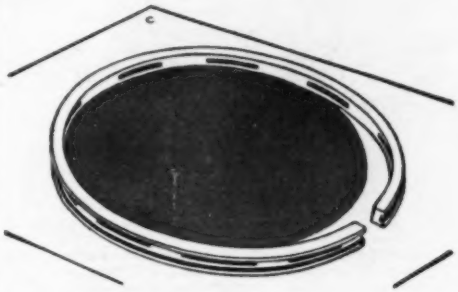
• • •

Old Bill Says . . .

Nov. 1931 When boring holes that are to be held to decimal dimen-

DON'T YOU BELIEVE IT!

THAT PISTON RINGS ARE ROUND



● Many people are under the impression that piston rings are made round. Burd "Graf-Flox" Piston Rings are purposely made *out-of-round* to insure uniform tension and perfect roundness when the rings are compressed around the pistons within the engine cylinders. Each type of ring has its own special metal formula to impart the right degree of hardness, flexibility, tension and long life for its specific use. The exclusive "Graf-Flox" process insures faster seating . . . without danger of rings scoring, seizing, or sticking in piston grooves. Burd "Graf-Flox" Piston Rings *stop* fuel and oil losses . . . *restore* pep and power. The coupon will bring you more information in two FREE booklets.

BURD PISTON RING CO.
ROCKFORD, ILLINOIS

MAIL THIS COUPON FOR THESE FREE BOOKLETS

BURD PISTON RING CO., DEPT. 128-H
Rockford, Illinois

I'd like copies of your "Servicemen's Handy Handbook" which tells how to keep my car in good working order, and the booklet "No Job For a Dab."

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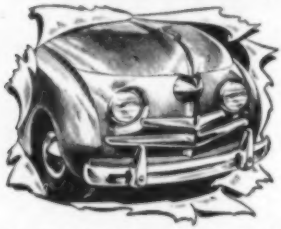
Address.....
City..... State.....

NOW CROSLEY HAS THE NEW LOOK



See the stand-out styling of the Crosley Station Wagon. All steel. Seats 4, or 2 with ¼-ton load. Priced $600 to $700 lower than any other station wagon, costs about ½ as much to operate. Also available as a panel delivery truck without rear side windows.

And all five Crosleys have the *new* look, massive radiator louvers and a gleaming spinner adapted from aircraft propellers. Every model features the startling 4-Cylinder Cobra (COpper-BRAzed) engine.

STATION WAGON: Goes everywhere smartly.

CONVERTIBLE: If you love sun and air.

SEDAN: Over 20,000 now on the road.

PICK-UP: Cuts service and delivery costs.

CROSLEY

a FINE car

For beautiful full-color catalog, write: Crosley Motors, Inc., 2532-JP Spring Grove Ave., Cin'ti 14, Ohio

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PLANS $1

5 sizes 8 to 40 cu.ft.

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PAINTERS' STRIPING TOOL

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NONE BETTER! SUPER DRILL GRINDER

Sharpens round shank drills from 3/32" to 1 1/16" in diameter, up to 11" long. Grinds old drills like new in 4 different point angles, using hand or power grinding wheels. Money-back guarantee.

Price only $2.98
At Dealers or Postpaid
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WOOD WORKERS

Lumber—Plywood Available

Harold Hunt wants to send you big new No. 15-A Catalog. Over 148 pages of woodworking ideas. 12 pages of rare woods in colors. UNEQUALED BARGAINS in imported and American woods, supplies, hard-to-find hardware. Send only 15¢ to cover postage and handling.

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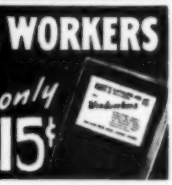
only 15¢



ADJUSTABLE BICYCLE SADDLE BRACKET

ONLY $1.00 POSTPAID

New, adjustable Saddle Bracket lowers saddle for use by younger children. Brings saddle down and forward so younger feet can reach and operate pedals safely. Simple, safe, sturdy steel bar. Easy to install and attach saddle. Adjusts 26" bicycle to 24" size. For boys or girls models. Made in ⅝ inch and ¾ inch diameters. Specify diameter desired. Postpaid anywhere in U. S. *Money back guarantee!*

Attractive Dealer Proposition. Write for Details.

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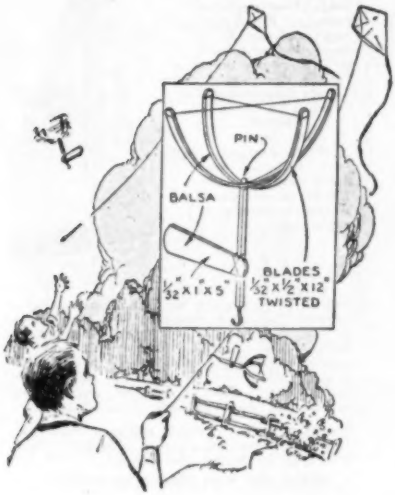
"I'LL TAKE THE WHITE ONE EVERY TIME!"

WYTEFACE
TRADE MARK
STEEL MEASURING TAPES

K+E
KEUFFEL & ESSER CO.

sions as to their center-to-center distance, it is best to drill the last hole undersize, insert a temporary plug, and test for the proper span.

• • •



Autogiro Model Drops from Kite String

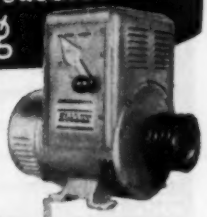
Sept. 1931 A small autogiro to fly from your kite string can be made from thin balsa and a stick. Make the four revolving blades as shown, and fasten them to the stick with a glass-headed pin so that they will turn freely in the wind. The blades should be very slightly twisted, all in the same direction. A thin balsa fin prevents the stick from turning. Make the hook from a wire paper clip, bent so that it can be dislodged easily when the kite string is jerked. The autogiro will slide all the way up the kite like a paper "message," and then float down when it is jerked loose.

• • •

Ice Used in New Method of Bending Metal Tubes

Mar. 1926 When bending small-caliber metal tubes, the common practice is to fill the tube, before bending, with molten resin, paraffin, or some metal alloy of low melting point. This prevents flattening the tube. A new method simplifies removal of the filler after bending. The tube to be bent is filled with water

Choose one of these "PROFIT MAKERS" for success in Arc Welding



1 **Your own electric power plus arc welding!** AC-AC Generator Only for building your own portable. AC welder—AC power plant.

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and then frozen in a refrigerating solution. The ice prevents flattening of the tube in bending. Afterward, the ice is melted and the water is blown out.

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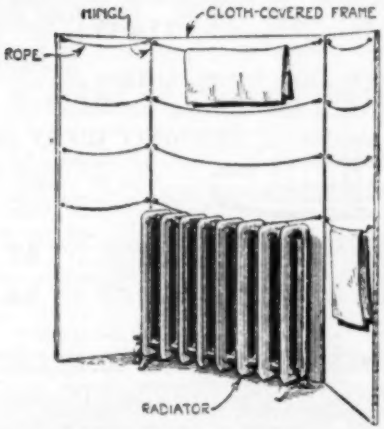

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• • •

New Trick for Tool Grinder

June 1926 Many ways of utilizing an old tool grinder will suggest themselves to those who have one but who do not possess a lathe. It will be found extremely useful, for instance, when painting small wheels for toys, especially the tires. These wheels can be made from spools, which will fit over the spindle of the grinder. A narrow, even band of color can be applied merely by holding the brush against the wheel while it revolves.

THE SAFEST WAY FOR WORK OR PLAY

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Prices FOB. K. C. Write for new catalog.

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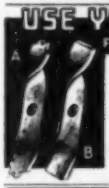
FOR JOINTING & CUTTING MOULDINGS



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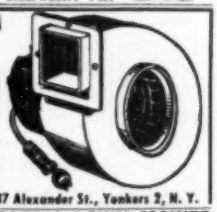

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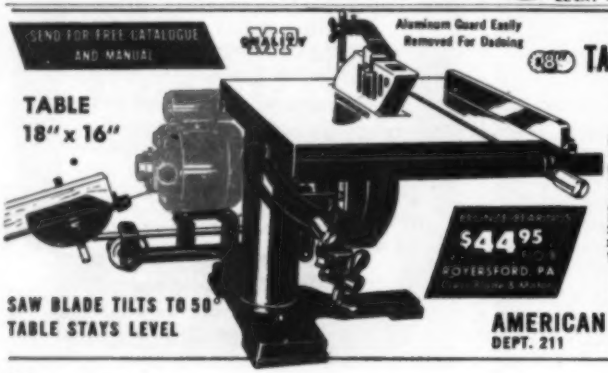

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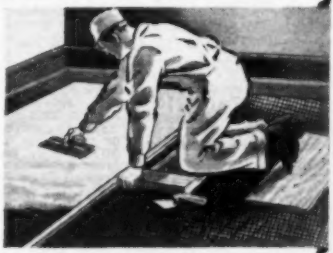

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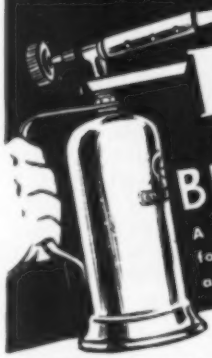

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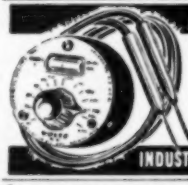

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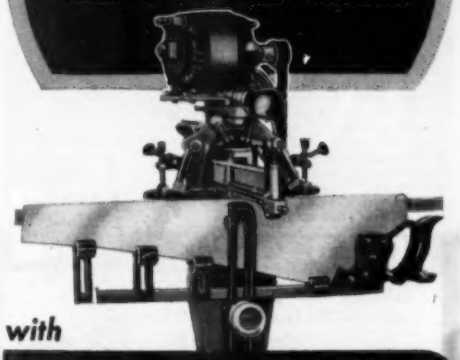

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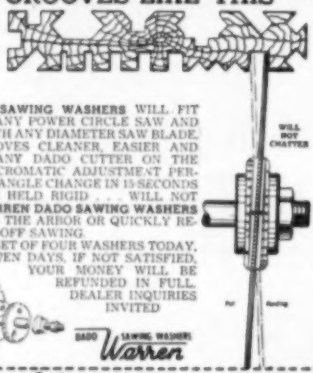

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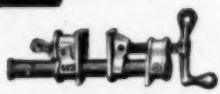

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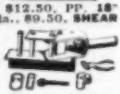

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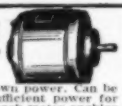

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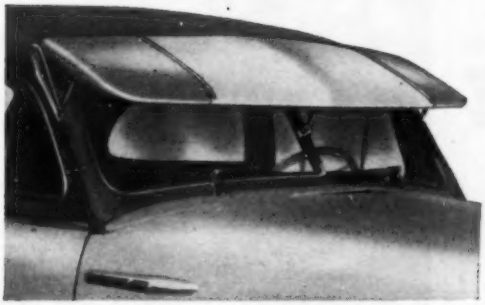

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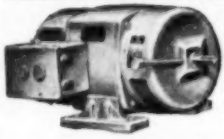

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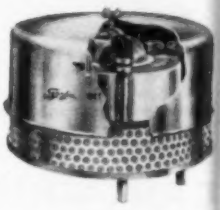

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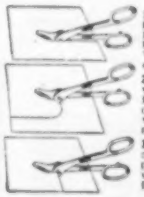

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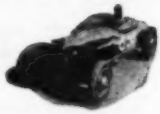

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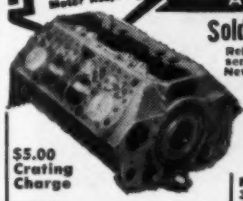

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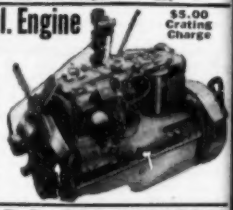

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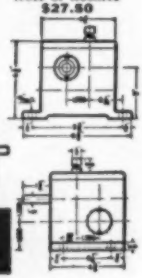

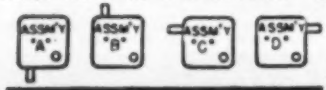

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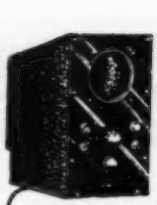

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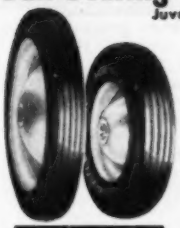

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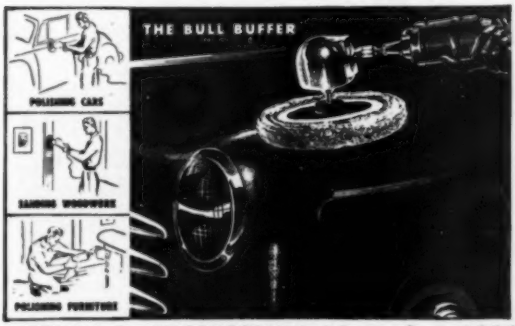

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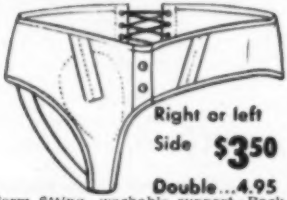

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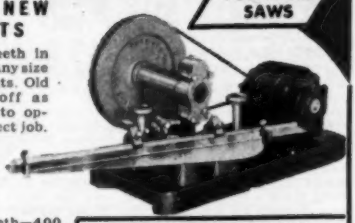

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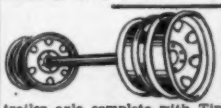

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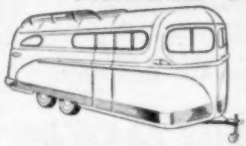

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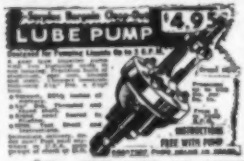

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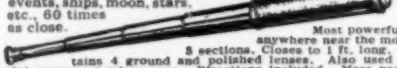

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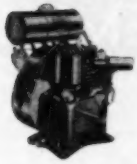

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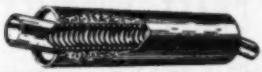

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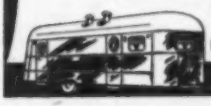

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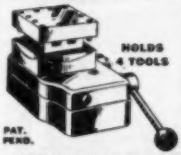

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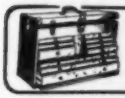

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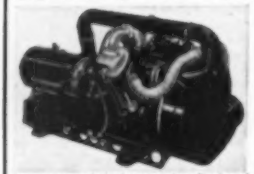

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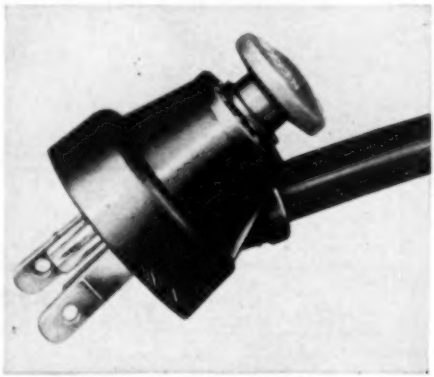

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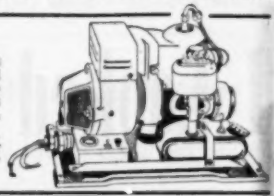

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This analyzer, featuring a sensitive repulsion type meter housed in a bakelite case, represents the culmination of 15 years achievement in the instrument field by a large company specializing in electronic test equipment.

Specifications of the AC-DC Model Volt-Ohm-Milliammeter:

AC Volts—0-25, 50, 125, 250
DC Volts—0-25, 50, 125, 250
Milliamperes AC—0 to 50
DC Milliamperes—0 to 50
Ohms Full Scale—100,000
Ohms Center Scale—2400
Capacity—.05 to 15 Mfd.

Total Price, prepaid anywhere in the U.S.A.—**$7.00.**
Similar DC Meter, lacking the AC operated ranges of above, **$5.50** prepaid.

Terrific Value—Portable Electric Drill

(Sold at less than established factory price so we cannot mention brand name)

Only $19.95 equipped with ½" Jacobs Geared Chuck and Key. Not an intermittent duty drill, but a full size rugged tool. Most convenient type switch, natural grip handle, and balance like a six shooter. Precision cut gears—turbine type cooling blower—extra long brushes. No stalling under heaviest pressure because of powerful 110 Volt AC-DC motor and multiple ball thrust bearing. Other bearings self-aligning lifetime-lubricated Chrysler Oilite type. Made for toughest year-in and year-out service in plant or on construction jobs.

Amazing perpetual factory guarantee assures you of a lifetime of trouble-free use. 25% deposit on C.O.D.'s. Full refund (you pay transportation) if not pleased with drill after trial.

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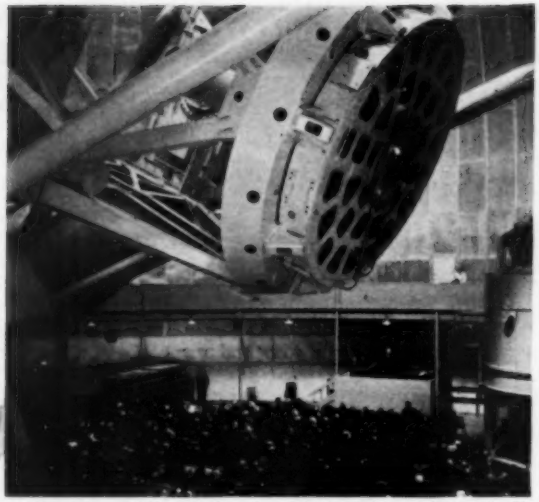
TO: Reader
FROM: Editor



Inside Palomar's dome (left), 800 people gathered for dedication of the Biggest Eye of all.

I Looked Through the Big Eye

I HAVE just come from enjoying an experience permitted to few laymen. I have looked through the eyepiece of the largest and newest telescope in the world, perched atop Southern California's Mount Palomar. I got a big kick out of it. And I think you would have, too.

The Big Eye was looking at Saturn. Its 200-inch mirror had gathered the light after its 900,000,000-mile journey into an image 700 times brighter than the view of Saturn you get with the naked eye. Around the greenish planet, for 50,000 miles on either side, circled a fantastic smoky corona.

Bringing in Saturn is of course child's play for the Big Eye. Dr. Ira S. Bowen, director of the observatory, can now photograph nebulae *six million times* farther out toward the fringe of the universe.

Does that word fringe sound strange to you? It should. it brings up the shocking idea that there may be a limit to space itself. Poking around Palomar, I found a lot of questions simmering in the minds of the astronomers there, questions that they hope the Big Eye will help to answer. For example, astronomers know that thousands of stellar systems larger than our own are rushing through space. How fast do they travel? How were they formed? Are they running away from us? Will there be few left for our descendants to see some day?

Talk to the men of Palomar, as I did, and you soon learn that these aren't questions that concern the scientific highbrows alone. Those lonely night vigils on a mountaintop that are an astronomer's life touch every crossroads village in the world.

How? We are entering the atomic age. Maybe disintegrating atoms will power machines, furnish heat, run steamships. But the atom is also the building block of the universe. Photographs and spectroscopic studies some day may show us how the atom formed those distant heavenly bodies.

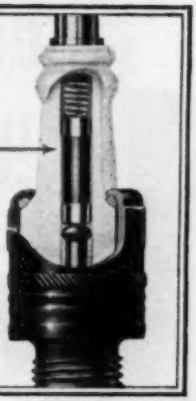
"How," asks Dr. Max Mason, chairman of the observatory council, "can you run a machine until you know HOW to run it?" With the giant telescope, Dr. Bowen will peer twice as far into the vitals of the cosmic machine as has been possible in the past. And in time more secrets of the cosmic machinery, brought to earth by the Big Eye, may find application in our day-to-day affairs.

Andrew R Boone

NEW

AUTO-LITE *Resistor* SPARK PLUG

NEW BUILT-IN "RESISTOR" AIDS PERFORMANCE



New Auto-Lite Spark Plug Has Built-in "Resistor" That Helps Deliver Smoother Idling, Better Radio Reception—Gives Improved Economy and Longer Electrode Life

Gives smoother engine idling

—because of the wider initial spark gap setting possible on the "Resistor" plugs. This assists in burning leaner mixtures, and reduces misfiring at idling and throughout the speed range.

Improves radio reception

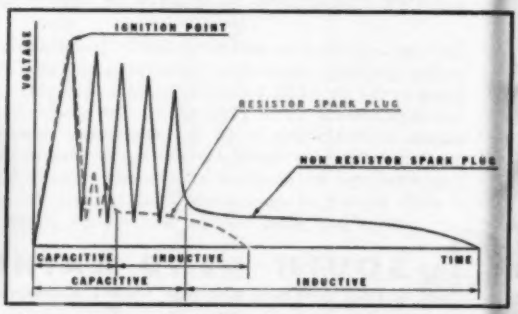
—by suppressing spark plug interference with radio, radio-telephone, radar and television reception. (Under 35 mv/m from 540 kc. to 150 mc. at 50 ft.)

Reduces electrode gap growth

—by increasing electrode life up to 200% and more . . . due to the virtual elimination of the inductive component in the spark discharge.

• • •

AUTO-LITE Ignition Engineers, working with leading automotive manufacturers, have developed the new Auto-Lite "Resistor" Spark Plug with this built-in resistor for improved operation and economy. Regular type Auto-Lite Spark Plugs (patented U.S.A.) will continue to be manufactured.



All spark plugs, including the new Auto-Lite Resistor Plug, ignite the fuel on the first peak of the capacitive component. However, the Resistor Plug dampens the remaining peaks so that radio, radar, and television interference is held to an acceptable level. Also, the Resistor virtually eliminates the inductive component that serves only to burn away the electrodes on ordinary plugs. The gap life is thus increased, making possible wider initial gap settings.

THE ELECTRIC AUTO-LITE COMPANY

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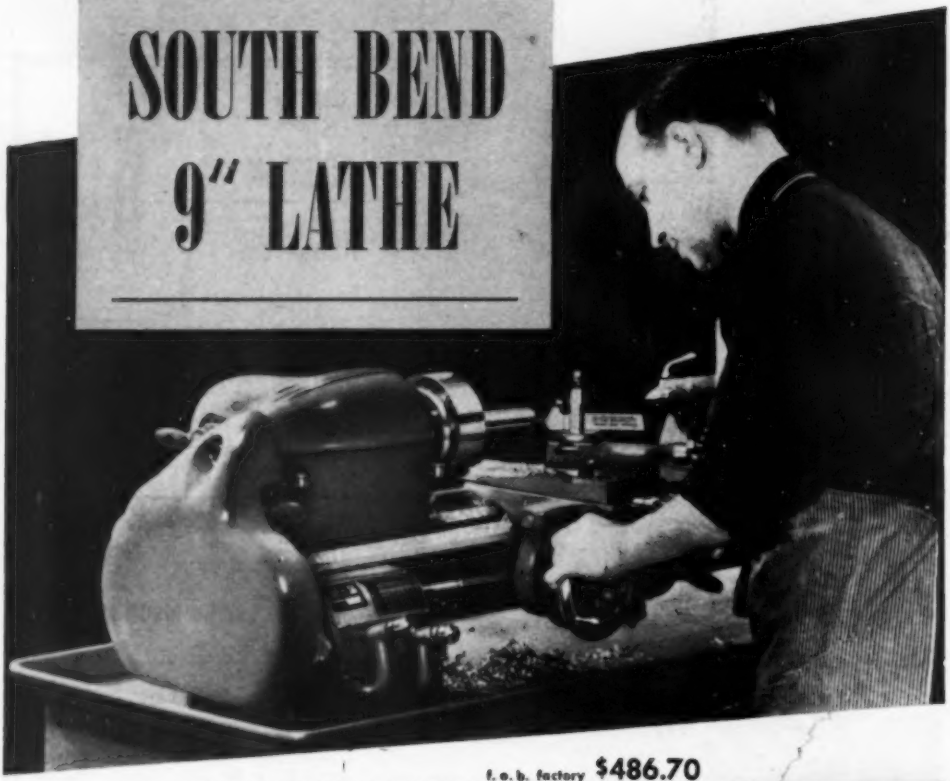
SOUTH BEND 9" LATHE



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with 1/2 h.p., 60 cy., 115 v. motor and switch. Other 9" lathe prices start at $145.

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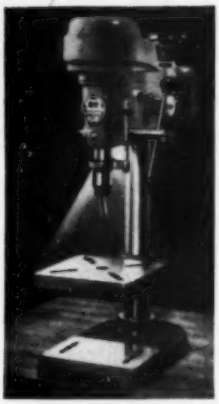

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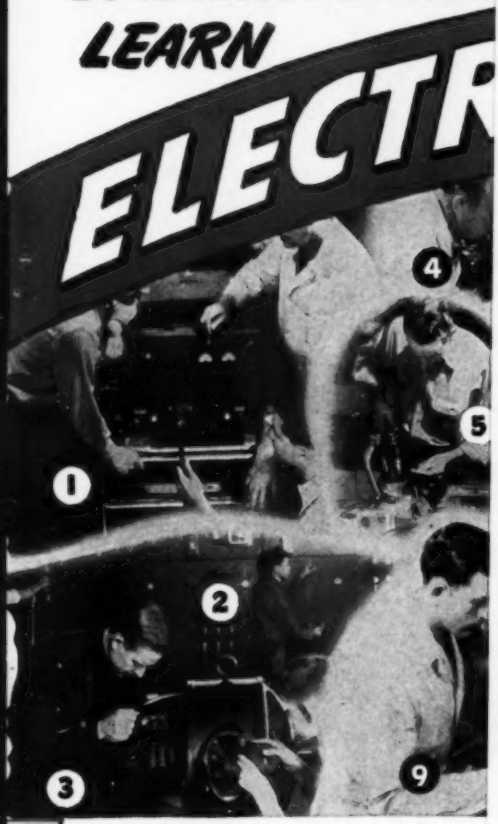

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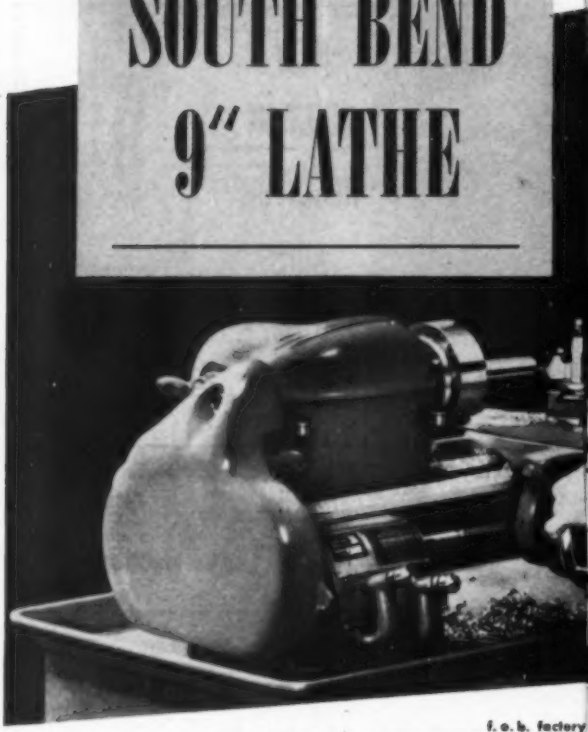
SOUTH BEND 9" LATHE



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with 1/2 h.p., 60 cy., 115 v. motor and switch. Other 9" lathe price

The accuracy and versatility of this 9" Underneath Motor L makes precision machining possible in any type of shop. A drive to the carefully balanced spindle assembly provides tion-free speeds up to 1270 r.p.m. The quick change gea makes available any of 48 different screw threads or fee 3/4" spindle bore facilitates the machining of bar or tu complete line of practical attachments greatly simplifies a wide variety of operations. Mail coupon for complete about this lathe, Catalog No. 344-ZN, or see our local

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